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FACTORY PRODUCTIVITY AND EFFICIENCY

I Problems of Measurement

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Introduction

This article is the first of a series of four, which together will form a report on a field study of factory efficiency and productivity. Our aim in this study was to find out by detailed analysis of various comparative indicators in in what ways and why one factory was more ' efficient ' than another in the same period or than itself in another period. The study was confined to three factories in the same line of business, and was further limited to their manufacturing activities; but it was otherwise comprehensive in that all types of manufacturing input were studied, and not just labour alone.

The three chosen factories were all manufacturers of electric motors—or, more exactly, of electric induction motors of horse-powers in the approximate range $\frac{1}{6}$ to $\frac{3}{4}$. Such motors have a wide and growing variety of uses, and in each factory several hundred different types of motor are made in the course of any year. Some, such as those for use in household equipment, are made on a very large scale, while others are made in tens or even in ones; and one key manufacturing problem in all three factories is to reconcile the pursuit of economies of scale with the need to satisfy such a variegated market. The heterogeneity of output is also the key problem for us, as its existence greatly complicates the task of analysis, and this problem is the main subject of this article. But the results of the analysis are likely to be more interesting; for it means that we are studying a situation in which the achievement of a high efficiency is a relatively hard task, and in which, therefore, it is likely that reasonably efficient factories will differ in the solutions they adopt.

In two respects our choice of industry was particularly fortunate. The factories were all medium-sized units, *i.e.* with employment of between 500 and 1,500, large enough to maintain a thorough system of records, but small enough for one to be able to grasp the full scope of factory activity.

But more important was the co-operativeness and kindness of the managements concerned. Unfortunately, we cannot thank individuals by name, as we have to preserve the anonymity of these factories; but that does not make our gratitude any the less. The first three firms we approached all agreed to help us, and all agreed to let us see any records we wanted. In each factory those with whom we dealt, and on whose time we imposed greatly, were unfailingly helpful and courteous, even in the later stages, when the study had turned out to take much longer than we had originally planned. We doubt whether there are many other academic enquirers who have been so generously treated, and we would like to put on record our sincere gratitude both to the firms themselves, and, even more, to the managers and their chief officials who made this study possible. Naturally none of them bears any responsibility for the use we have made of their figures, or for the views we have expressed.

The Framework of Measurement

We stated our aim in this study to be to find out why and in what ways one factory was more ' efficient ' than another or than itself in another period.[1] In this first article we want to describe some of the chief difficulties that arise in building up a set of comparative measures for detailed aspects of performance from the figures which factories record in the normal course of their business. We also want to comment on the meaning of efficiency implied in the particular set of measures we intend to use.

Fundamentally, our technique is to calculate a set of productivity measures for particular kinds of input—direct labour, direct materials, equipment, etc. Clearly a comparative productivity measure for a particular type of input is only likely to be an indicator of ' efficiency ' in its use if substitution between inputs can be ignored. Ultimately it cannot; but we must distinguish between direct and indirect forms of substitution. In this enquiry most of the direct and therefore measurable forms of substitution are minor. On the whole the factories use rather similar types of equipment, and there is no marked direct substitution between labour and capital. So too the factories buy most of their materials in similar forms; and adjustments for substitution between direct material and other inputs arising because one factory manufactures a component which another buys ready-made can be confined to the level of detail.[2] The more important forms of substitution are of an indirect, complicated and scarcely measurable kind—consider, for instance, the substitution of direct materials for most other types of input that may be involved in a greater standardisation of components. We shall make no attempt to adjust our measures of productivity for such forms of substitution, preferring to leave their elucidation to detailed comment. So all productivity measures for particular types of input are to be regarded as merely *provisional* indicators of efficiency in their use.

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[1] Since the continued repetition of the twin purposes would be tedious, we shall take it to be understood that the term ' another factory ' covers the same factory in another period, except where the context makes it clear that this is not so.

[2] This was fortunate. In an American study of the productivity of six factories in the electric motor industry, one performed only the final assembly operations which in another accounted for a mere 10 per cent of the total work done.

So let us ignore substitution and consider how to set up comparative measures of productivity on the assumption that no substitution exists. Consider just one type of input—say direct labour. Other things being equal, the use of more direct labour on a similar job is a sign of lower efficiency, and this formulation immediately raises the two key problems—what is ' more direct labour ' and what is a ' similar job '. The first problem can be dismissed briefly at this stage. There are two simple measures of direct labour usage, one in terms of total cost and one in terms of total hours of work. If these were proportional in different factories, *i.e.* if cost per hour of work were similar, then it would not matter which measure one used; but if, as it turns out, they are not, the right course is to use both measures, until one has had a chance to elucidate the reasons why the two differ. Indeed, we shall find that the analysis of inter-factory differentials in earnings per hour, involving, as it does, important questions concerning the ' quality ' of labour, has a major part to play in the analysis of our measures; but it is not one that would be helped by *a priori* speculation as to which is the better measure of direct labour usage, apart from the obvious comment that in comparisons over time measures by cost are likely to be less useful than those by hours. A similar contrast between financial and physical measures, though with rather different implications, arises for all types of inputs; and in what now follows we shall throughout use the neutral term ' usage ' to cover both physical and financial measures of input.

The second problem cannot be dismissed so summarily; for it is the key problem in a study of the multi-product motor industry. In each factory the major manufacturing problem is how to combine the economies of large-scale production with the need to make several hundred different types of motor to meet the various needs of customers. Our simplest course would be to treat the manufacture of every motor as a similar job by measuring productivities simply as ratios of inputs to numbers of motors made, regardless of type;[1] but, since the composition of output does differ substantially between factories, differences between the costs of different motors are too large to permit such a crude approximation. In effect, there are two types of compositional difference that have to be taken into account. First, although the factories are competitive over a wide range, there are substantial differences in the ranges of intended uses of motors for which each caters, so that one factory makes motors for uses for which another could not cater. Output of such motors will be called ' non-comparable ', and we shall exclude them from the comparison, by subtracting from the total usages of inputs any amounts attributable to motors without ' equivalents ' in another factory.

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[1] Account also has to be taken of output that does not consist of new motors—*e.g.* work on spare parts or in building up component stocks and work-in-progress. The difficulties here arise mainly from the lack of reliable data, and will not be further discussed.

The subtraction can be done with fair accuracy for direct inputs, but is necessarily more difficult, both in principle and in practice, for overheads. Second, within the common range of uses, there are variations in the proportionate importance of different types of use. Taking account of such variations is made more difficult by the fact that each factory manufactures to its own designs, so that a motor made in one factory is a different product from that made in another to fulfill the same purpose. However, we did find it possible to identify with reasonable confidence the motor that one factory would have made to serve the same use as that served by a motor made by another; and we could therefore, for the comparable part of output, identify the ' equivalent ' output that another factory would have made to satisfy the same demand, a step that allows one to compare productivities by estimating the inputs that would have been used to make equivalent outputs. On this approach design differences between equivalent motors fulfilling the same purposes are ignored in establishing productivity measures. The interpretation of such measures must depend on the nature of such design differences; but the problems which arise are better considered in the more specific context of later articles.

Suppose that at factory A comparable output consists of motors of several types, of which $n_r^{(A)}$ of the r^th^ type are made. Then, as each factory maintains a cost accounting department, there will exist records specifying in some detail what inputs were used to make each type. Suppose that the usage of direct labour per motor on the r^th^ type was $l_r^{(A)}$. Then the total usage of direct labour in making all comparable output (given that cost accounts are accurate) would have been

$$\sum_r n_r^{(A)} l_r^{(A)};$$

and, if one could assume that the $l_r^{(A)}$'s were independent both of the scale of manufacture of the r^th^ type, and of the manufacture of other types, the expression

$$\sum_r n_r^{(B)} l_r^{(A)}$$

would be an estimate of the direct labour that would have been used to make an output containing $n_r^{(B)}$ motors of the r^th^ type. If the $n_r^{(B)}$ are the numbers appropriate to the output at A that would be equivalent to the comparable part of the output actually made at B, this expression can be compared with the actual direct labour usage at B on comparable output, leading one to propose as a comparative measure of direct labour productivity at A and B the ratio

$$\sum_r n_r^{(B)} l_r^{(A)} \Big/ \sum_r n_r^{(B)} l_r^{(B)}.$$

Dropping the phrase ' the comparable part of output ', we shall call this measure the ' relative productivity on B's output '. The alternative measure obtained by inter-changing A and B will be called the ' relative productivity on A's output '.

A point to notice is that we can take out a general factor of scale without altering either measure. In the alternative form

$$\frac{\sum\limits_r n_r^{(B)}\, l_r^{(A)}}{\sum\limits_r n_r^{(B)}} \bigg/ \frac{\sum\limits_r n_r^{(B)}\, l_r^{(B)}}{\sum\limits_r n_r^{(B)}}$$

it is made clear that the comparison is really between the actual average usage *per motor* at A for an output equivalent in composition, but not necessarily in scale, to that made at B. Since the most plausible general hypothesis is that this estimate is likely to be best for an output of the same general scale as A's actual output, it would be more accurate to describe our measure as one of ' relative productivity on an output of B's composition ', and thus make it clear that the general scale of output is throughout treated provisionally as a causal variable of productivity. This is of course the normal treatment implicit, for instance, when output is measured in terms of numbers produced and productivity in terms of resources used per unit of output.

Several other formulations are also useful. For instance, in analysing direct material usage we shall write the comparative productivity on B's output as

$$\sum_r \left(\frac{n_r^{(B)}\, m_r^{(B)}}{\sum\limits_r n_r^{(B)}\, m_r^{(B)}} \times \frac{m_r^{(A)}}{m_r^{(B)}} \right)$$

(the m_r's being direct material usages on the r^{th} type), a form which brings out the fact that the measure is a weighted average of comparative productivities for particular motors, in which the weights are the actual shares of particular motors in the total usage of direct materials in factory B. A further refinement is to write the productivity as

$$\frac{m_1^{(A)}}{m_1^{(B)}} \times \left[\sum_r \frac{n_r^{(B)}\, m_r^{(B)}}{\sum\limits_r n_r^{(B)}\, m_r^{(B)}} \times \left(\frac{m_r^{(A)}}{m_1^{(A)}} \div \frac{m_r^{(B)}}{m_1^{(B)}} \right) \right]$$

In this form, the whole of the bracketed term can be regarded as a factor which measures the typicality of one particular single-product comparison in relation to the average of all single-product comparisons that might have been made.

For inputs other than direct materials a different formulation is useful. Up to this point we have been assuming that cost accounting records from different factories are directly comparable; but in practice they are not. If they were, and if we were to write $L_r^{(A)}$ $(\equiv \sum_r n_r^{(A)}\, l_r^{A})$ for total direct labour usage at A on comparable output, we could write our original expression for comparative productivity on B's output in the more complicated form,

$$\frac{\sum\limits_r n_r^{(B)}\, l_r^{(A)}}{L^{(B)}} \bigg/ \frac{\sum\limits_r n_r^{(A)}\, l_r^{(A)}}{L^{(A)}}.$$

The denominator in this expression is identically equal to unity; but we shall use this latter expression even when the identity does not hold in the hope that the effects of inconsistencies and inaccuracies in the cost accounting records on numerator and denominator will be roughly similar. So our productivity measures are seen to be ratios of measures of output per unit of input, the output measures being calculated by taking as weights for individual motors usages on them in one factory. Weights based on B's usages correspond to comparative productivity on A's output, and *vice versa.*

Productive Efficiency

Before we discuss the problems that arise in computing these measures in practice, we should like to comment on the implications of our choice of measures for the kind of efficiency we are actually investigating. For this purpose, we shall assume both that the records we have to use are accurate and consistent, and that no problems arise in connexion with either the exclusion of non-comparable output or the identification of equivalent motors. So for the moment let us suppose that all output is comparable, and that there are no differences of design between equivalent outputs.

A crucial assumption in the development of our set of measures was that the l_r's—the usages of direct labour on particular motors—were independent both of the scale of manufacture of the r^{th} type of motor and of the manufacture of other types. Clearly this is a rather arbitrary assumption, and it is the main theoretical drawback to the set of measures we propose. If in reality a factory were to be faced with the job of making an output similar in composition to that of another factory with a substantially different output, it is inconceivable that even with unchanged techniques costs per unit on each particular motor would not be altered. Probably motors required in larger numbers would become cheaper—if not for direct materials, probably for direct labour, and almost certainly for overheads. Moreover, the techniques and organisation of manufacture would quite probably be altered. Consider, for instance, one of the factories in which there were three rather similarly equipped manufacturing lines. On one line five different types of motors, all in very high demand, were made; on another eighty types, all in fairly regular demand; and on the third several hundreds. At any given moment, there existed a general instruction specifying on which line any particular motor was to be made; but this instruction could be—and was—varied at short notice in order to ensure sufficient work for the first two lines. But the assumptions that the l_r's would not alter if the composition of output altered involves the assumption that such variations would not be made, and is therefore in contradiction with the known facts.

It may be that, in particular cases, more realistic assumptions can be introduced after detailed investigation; but in general these shortcomings just have to be accepted. They are most likely to take the form that, in a comparison of productivity between A and B, measures based on A's output will be unfair to B, because the estimate of B's usage on A's output will be too high, and *vice versa*. Moreover, the bias will be particularly marked against one type of factory, which we might call ' temporarily specialised ', *i.e.* one in which the cost of manufacture per unit for particular motors varies substantially according to the scale on which that motor is made, but in which the manufacturing facilities are flexible in a way that permits the most economical facilities to be switched to whatever motors happen temporarily to be in greatest demand. The factory just described is of this kind, and, as a result, we must be prepared to find a fairly sharp divergence between the two alternative measures of comparative productivity for any particular type of input.

Although such divergence is a general characteristic of index numbers in economics it is worth stressing that there are many other reasons for expecting the divergence to be particularly sharp for our kind of productivity measures. In general, one has to expect that a factory will be better suited to the manufacture of the output it actually makes than to most others. This may come about because of a deliberate specialisation of manufacturing facilities. But, even in the absence of this, *de facto* specialisation is likely to be found. For, if a factory should happen to hold a relatively high share of the market for a particular type of motor, the incentive to seek economies in its manufacture will be correspondingly great. Moreover, if for any reason it should happen to make a particular type of motor relatively cheaply, the fact that it thereby has a greater incentive to expand sales of that motor will tend to enhance the importance of any specialisation that may exist. Therefore, even when our measures do not involve unrealistic assumptions about the way in which and the cost at which a factory would make some other output, comparative measures of productivity based on some other factory's output are likely to be loaded in favour of the latter factory. In a comparison between two factories, one of our measures is likely to be ' unfair ' to one factory, and the other to the other; but the degree of ' unfairness ' depends on the extent to which each factory has chosen to specialise its manufacturing facilities to meet the particular requirements of its own customers. If a factory is unspecialised, it is thereby the much more likely that it can manufacture economically some other structure of output, a fact to be counted to its credit if, and only if, it is likely that this other output is one that it will at some time be required to produce. Thus, as between a factory with specialised manufacturing facilities and one not so equipped, one of our measures can be regarded as more ' unfair ' to the former than is the other to the latter; for, while in the second measure a development is being allowed for which the latter factory is well adapted to meet, the opposite is true of the first measure. Specialisation of a permanent kind involves taking a risk, and in one measure it is implicitly assumed that it has not wholly come off. Of course, the best check would be to extend the comparison over a long period, so that changes in the structure of output would have had time to appear. But, short of that, all one can do is to note that ' unfairness ' is implicit in the measures we use.

In such circumstances it is naturally tempting to enquire if some alternative approach might lead to more intrinsically 'fair' comparisons. In general our answer is 'no'; measures confined to particular types of input are almost bound to be 'unfair'. But for measures embracing all inputs there is a possible alternative approach.

Consider first the measures for productive efficiency implicit in our system. In the particularly simple case in which the usage of each input is measured in terms of cost it is easy to see what these are. Suppose that the total cost of the r^th^ type of motor, c_r, is composed of l_r of one type of input, m_r of another, etc. Then, if total factory costs are given by C, the expression

$$\sum_r n_r^{(B)} c_r^{(A)} \Big/ \sum_r n_r^{(B)} c_r^{(B)}$$

can be written as

$$\frac{L^{(B)}}{C^{(B)}} \times \frac{\sum_r n_r^{(B)} l_r^{(A)}}{\sum_r n_r^{(B)} l_r^{(B)}} + \text{similar terms in m, etc.,}$$

that is, as a weighted average of measures of productivity for particular types of input based on the output in factory B. As before, if we write

$$C^{(A)} \equiv \sum_r n_r^{(A)} c_r^{(A)},$$

this expression can be written as a ratio of outputs per unit of input in the form

$$\frac{\sum_r n_r^{(B)} c_r^{(A)}}{C^{(B)}} \Bigg/ \frac{\sum_r n_r^{(A)} c_r^{(A)}}{C^{(A)}}.$$

Input is measured in terms of total cost, and the measures of output are calculated by taking as weights for individual motors their total costs of manufacture at A. Measures of productivity based on output at A add up to a similar measure for productive efficiency in which individual motors are weighted by their total costs at B.

We may regard these expressions in another light as value judgements. If instead of asking as we did 'What resources would A have used to do B's job?' we had asked 'How much more valuable are the results of A's work than B's?', we would have been led to define higher efficiency in terms of a higher figure for the value of output made per unit of value of resources used. So we may say that in our approach output is 'valued' in such a way that the relative values of different motors are given by their relative costs of manufacture in one factory.[1]

Clearly, there is something unsatisfactory about such a system of valuation. It has the obvious drawback that in it motors are valued on the basis of the facts from one factory, whereas, instinctively, one would feel that, in valuation, one should try to abstract from the particular way in which one factory has chosen to tackle its particular manufacturing problem. One might, in principle, try to achieve this by substituting for one factory's costs average costs over all factories in the industry; but, in practice, the only real alternative would be to use some form of market valuation for output. One might, for instance, substitute selling prices for manufacturing costs in determining the relative value of different motors. Relative selling prices of motors from different factories seem likely to prove rather more uniform than relative manufacturing costs; and so the divergence between the alternative measures that would arise from the use of different factories' prices seems likely to be less than the divergence associated with our set of measures. As so much of this divergence appears to be associated with the ' unfairness ' inherent in productivity measures, it might well be that some system of market valuation would be preferable in any study in which it was desired to relate *single* indicators of productive efficiency to other economic indicators.[1]

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[1] In the more complicated cases, in which some inputs are 'valued' in other ways, the implied system of 'valuing' output is also more complicated; but the simple case will suffice for our present discussion.

Moreover, in spite of its obvious deficiencies, such a system does in principle take into account aspects of performance which ideally one would wish to have included in a comprehensive study of factory efficiency. Consider, for instance, the issue of flexibility in manufacturing facilities. Other things being equal, a factory which can alter the composition of its output quickly in response to changing market demands is likely to incur higher manufacturing costs than one which cannot. In any market valuation these extra costs would be set against any extra revenue that derives from this flexibility; but, since in valuation by cost there would be no such offset, our whole approach is almost bound to be biased against the factory with flexible facilities. This is only one example of important aspects of performance that cannot be analysed in terms of our approach. Indeed what we want to stress is that all our measures of productivity for particular types of input are really provisional, not only because possible substitution effects have been ignored, but also because the concept of productive efficiency implicit in them is itself provisional. Whether in practice it is a useful concept is something that only detailed analysis of the particular circumstances can reveal.

MEASUREMENT IN PRACTICE

The set of measures we have laid down require at least two kinds of information—about the level and composition of output, and about the level and composition of inputs used to make individual motors. We do not intend in this article to say much about the problems that arise in gathering information about output, for they are mostly highly special to the electric motor industry. For instance, it is in each factory possible to obtain easily a comparable figure for the number of new motors made in a period; but, if we want to go on to measure anything concerned with the composition of that output we have to refer to a large number of technical records, in which the physical properties of a motor of a specific reference number are described. All we need say is that in each factory the information we did gather consisted of three kinds—accurate figures for the numbers of new motors made, full technical descriptions for a random sample of these, and some limited information concerning other output such as that of spare parts. Naturally, the use of sampling techniques means that all our productivity measures are subject to sampling error (c. 1–2 per cent); but, as this error is both smaller and more predictable than that arising in the measurement of inputs, one can for most purposes regard the samples as adequately representative.

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[1] *c.f.* the study described by Jack Downie in his book *The Competitive Process* (Duckworth, 1958). Curiously (p. 45), for measuring output he regards prices as an unsatisfactory substitute for costs. We suspect this to be an illustration of the general rule that one is always more acutely aware of the deficiencies in the figures one has than in those one has not. We made no attempt to collect information concerning selling-prices; and we suspect that, if we had, their deficiencies—conceptual and practical—would have loomed just as large as those we have been discussing: consider, for instance, the valuation of motors transferred at cost to other factories under the same ownership.

Let us assume therefore that we know accurately what was produced, and concentrate on the problems of discovering what inputs were used in making each individual type of motor. For this the only records in each factory are the cost accounting records, in which an attempt is made to attribute to each product its appropriate share of total expenditure. In all three factories, the cost of an individual motor is made up of three elements—direct materials, direct labour, and overheads, of which only the first two are computed in any detail. The third is calculated by some arbitrary procedure, usually the allocation of overheads to individual motors *pro rata* to their total direct labour cost.[1] So, even for those few overheads for which such figures might theoretically be recorded, no figures for the usages of particular overhead inputs on individual motors really exist, and any detailed comparisons of overhead usage have to be based on other records. So let us begin by considering problems concerned with measuring the usage of direct inputs, materials first.

Direct Materials

A cost accounting record is a record drawn up for the convenience of the individual factory. There are no legal requirements, or accepted accounting conventions, that determine what are or are not direct costs, still less any that specify exactly how they are to be computed for individual motors. Consequently, one has to expect that direct cost may mean different things in different factories. However, for direct materials all three factories find it convenient to employ much the same definitions and techniques of computation. For each motor there is drawn up from the design specifications a list of the quantities of each required material (including 'bought-out' components). To each item in this list, a price per physical unit is attributed, so that for each required material the cost accounting records show both a physical and a financial figure relating to the usage as necessitated by the design. The full direct material cost is then obtained by adding on to the total of the specifically calculated items a further small percentage to take account of elements such as the cost of scrap. The cost accounting records therefore appear to provide the means for making direct comparisons in detail between factories both in physical and in financial terms, without any need to appeal to records for the total usages of direct materials, and this is in essence the way we shall use them.

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[1] This statement is somewhat of an over-simplification. In one factory, the allocation is done separately for each manufacturing department, and in all a small part of total overhead cost is allocated on somewhat different principles.

Further investigation qualifies this picture substantially; for, as between records from different factories, it reveals a large number of detailed sources of inconsistency. Physical figures are rarely exactly comparable—treatment, for instance, of the scrap that is necessarily associated with the process of manufacture varies; and we found it essential to supplement the cost accounting records with other physical figures, some obtained by measurement of specimen motors and some deduced from the detailed engineering drawings. Figures for prices per unit are even further from exact comparability. For instance, while one factory costs according to the average prices of materials invoiced in the previous complete period of three months, another uses standard prices, *i.e.* prices specified towards the end of each year as ' targets ' for the following year. These minor sources of inconsistency were not large enough to obscure major differences in the kind or quantities of materials used, such as those associated with substantial differences in design; but they did make it impossible to attach significance to minor differences. In particular, we could rarely discover whether differences in apparent costs per units of rather similar materials were to be attributed to inconsistencies in cost accounting techniques, or to real differences in prices paid for identical materials, or to minor differences in the quality or the form of delivery of similar materials. So, in practice, we found that the study of direct material productivity turned out to be largely a study of the effects of design on material usage.

We did try to supplement the cost accounting records from other sources in order to cover other aspects of efficiency in the use of materials. We did gather some useful comparable information about the costs of scrap; but, otherwise, we did not find that an appeal to other kinds of records was helpful. In particular, the familiar difficulties associated with the measurement of changes in material stocks and in the material content of work-in-progress meant that no useful additional information could be obtained from accounting records of total expenditure on direct materials. Figures for the cost of materials used in making the output of a particular period derived by adjusting figures for purchases for changes in stocks proved to be rather less exactly comparable than were ones derived from the cost accounting records. So we had to exclude from our study entirely one important aspect of factory performance, namely the extent to which and the reasons why one factory obtained materials more cheaply than did another. The most we could be sure of was that in this study differences in 'purchasing efficiency' were not a major cause of differences in 'productive efficiency'.[1]

Direct Labour-General

Cost accounting records for direct materials in different factories are roughly, though only roughly, comparable; but even this modicum of comparability is lacking for direct labour. The full extent of incomparability took us by surprise; and, since in comparisons between factories, comparisons of direct labour productivity must form the core, we want to discuss the sources of incomparability in some detail.

The most fundamental source is a lack of agreement as to what labour is 'direct'; for this affects all records of labour input—factory accounts, payroll, and cost accounts. In one factory, the recorded total cost of direct labour was 46 per cent higher than in another; but we found that on a consistent definition the cost would actually have been 1 per cent lower. Many sources of discrepancy are immediately apparent. Consider, for instance, the classification of the workers on the line who test that products fulfill the required specifications. In one factory these are direct, in another indirect, and in the third, they are direct for some records, and indirect for others. But such discrepancies in the classification of workers are not the real source of difficulty; for usually some records can be found that will permit the derivation of reasonably accurate and comparable figures referring only to workers whose primary job is doing the manufacturing operations required to make motors.

Much more troublesome are 'charge-outs'. In each factory some of the time of direct workers will be charged-out from the direct labour account to other types of account, but what and how much is charged-out depends on what it is convenient to charge out, and is therefore determined by the nature of the information that has to be recorded in the process of computing the weekly pay due to each wage-earner. This in its turn depends on the system of payment in use for direct workers, and it is largely because each factory studied had a different system of wage payment that the measurement and analysis of direct labour productivity proved far more difficult than might be expected.

Of the three factories, one pays purely by time, one pays by the piece according to the standard form laid down in national agreements for the engineering industry, and one had a complicated system of its own which we shall call 'mixed'. In the time-working factory each worker has a fixed rate per hour made up of the nationally-negotiated minimum rate for his grade *plus* a personal bonus rate fixed every six months on the recommendation of his immediate superior. In the pieceworking factory nearly all direct workers receive both time and piece payments. The former are based on nationally-negotiated rates per hour lower than those for corresponding time-workers; the latter are based on rates per piece for each operation or group of operations performed, the rates being initially settled on the basis that a pieceworker of ' average ability ' should be able to earn at a certain rate per hour dependent on his grade. The piece-rates once fixed remain unchanged unless there is a change in circumstances, and since 1950 all wage increases have been given in the form of increased time-rates. As usual in engineering, the pieceworker of 'average ability' is a fiction, the actual average being far above the notional one.

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[1] A similar exclusion had to be made in comparisons of a single factory over time; but in that case the exclusion is more to be expected because of the obvious difficulties of segregating price changes due to increased efficiency in purchasing from those due to market forces.

In the third factory elements of both simpler systems are found. As in the timeworking factory, each worker has a personal time-rate (a sum of a base-rate and a small merit rate), which determines his minimum payment per hour; but, in addition, two types of incentive bonuses are payable. First, for each operation a time is prescribed and a worker is paid for any hours he saves in relation to that time at a rate somewhat below his personal time-rate. Therefore, as the prescribed norms are again based on the notional worker of average ability, most work is paid for more according to the hours it should take than according to the hours it did take, a kind of piecework payment but one in which the actual piecework prices depend on the personal time-rate of the individual operative; but a few very slow workers will be paid purely by the hour. Second, every worker in the factory, direct and indirect, wage-earning and salaried, receives an incentive bonus calculated monthly on the overall performance of the factory in relation to laid-down targets.

Each of these three systems leads naturally to one particular method of recording labour usage for the purpose of calculating wages due. In the timeworking factory, the basic record is the clock-card, recording times of arrival and departure. In the piece-working factory, this record has to be supplemented by piecework tickets for each operation or group of operations performed, recording what was done and its price. (These piecework tickets are also made the basis of the production planning system, and the differing payment systems thus also lead to differing systems of manufacturing control; but that is another story). In the ' mixed ' factory, the number of required records is very large; for each individual pieceworker[1] a separate entry on his clock-card is required for every operation, and the system would be virtually unworkable without the expensive punched-card equipment installed in the office.

Consider just one example of the effect of these differences on the meaning of direct labour. In the kind of mass production engineering work done in these factories, and with the semi-skilled labour they all use, some work is bound to be faulty. Faulty work may lead to scrapping; but more usually it will call for some ' re-operation '. In the time-working factory there is no need to distinguish between re-operation and ordinary work, and consequently direct labour there includes time spent on re-operation. In the mixed factory, all re-operation work is paid purely by time, and so it is separately recorded in the payroll and can be excluded from direct labour. In the pieceworking factory, some of it, but only some of it, will be separately distinguished, as there the worker who has to make good his own faulty work receives no extra piecework payment, but a worker who makes good somebody else's faulty work (or faulty work not attributable to any individual) gets a special piecework payment authorised by a separately-issued ' waste-ticket '.

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[1] Many direct operatives are paid group bonus, in which the time saved is computed for the whole group on a weekly basis. The records for such workers are of a totally different kind, and lead to the oddity that in the weekly records of labour usage (but not in the monthly accounts) direct labour excludes the time of individual pieceworkers spent on non-productive operations, but includes that of group pieceworkers similarly engaged.

The difference between the meaning of ' waste labour ' in the last factory and of ' re-operation labour ' in the second factory illustrates well one of the chief dangers of inter-factory comparisons—the assumption that apparently similar terms have roughly similar meanings. In fact, the latter may be nearly twice as large as the former solely because of the definitional differences, a far from trivial difference in a department where re-operation work accounts for over 30 per cent of the time of direct operatives. In practice we found that such figures could not be standardised to any acceptable standard of accuracy, and that comparable figures for direct labour usage could be calculated only on the basis that direct labour consisted of *all* the working time of operatives whose main job is doing or re-doing the operations necessary to manufacture, by adding back into the total of direct labour any part of the time of direct operatives which has been charged-out to other accounts. In effect, one has to unscramble the accounting systems, with the incidental consequence that in the process one has to elucidate much detail concerning the labour items charged to overheads, so that the extra work needed to obtain a complete coverage of overhead costs is much less than might be expected. Another consequence is that the most time has to be devoted to unscrambling the accounts in the factory with the most thorough accounting system, since in that factory great pains are taken to exclude from direct labour any part of the time of direct workers not actually spent on doing manufacturing operations—a sad fact because ideally that is a measure of direct labour usage that it would be useful to have in all three factories.

Actually much unscrambling has to be done even in comparisons of a single factory over time. Except in the ' mixed ' factory,[1] all records of hours worked are simple summaries of information in the payroll, and so are inconsistent with records of cost taken from the final factory accounts, the only readily available record of non-labour expenditure other than that on direct materials. The job of reconciling these two types of record was far from straightforward. In the pieceworking factory, ' direct ' hours as taken from the payroll proved to include 8 per cent of hours whose cost was later charged-out to other accounts; while, on the other hand, direct labour cost in the accounts also included the cost of another 14 per cent of hours classified in the payroll as ' indirect '. Since, as will be seen from Table I, the average

[1] In that factory, unscrambling also proved necessary, but only because, in the course of the period covered, the definition of departments and of some items of cost were altered.

TABLE I

Analysis of Direct Labour Cost in One Factory

	Pay or cost	*Hours worked*	*Pay per hour*
Payments to workers classified as direct in the payroll...	100	100	100
Transfers to other accounts:			
boxing and packing	−1.5	−1.5	78
training	−1.6	−2.9	
idle time	−0.7	−0.9	
inspection	−0.4	−0.4	
other	−1.7	−2.0	
	−5.9	−7.6	
Net payments to pieceworkers included in direct labour cost in firm's accounts	94.1	92.4	102
Transfers from payments to timeworkers into direct labour:			
setters	+8.6	+7.6	111
testers	+5.0	+4.5	
other	+1.9	+1.8	
	+15.6	+14.0	
Direct labour cost in firm's accounts[1]	109.7	106.3	103

[1] Excluding premium payments for overtime or shift working, and excluding the effect of any transfers in and out done on a monthly basis.

rate of pay for hours transferred into direct labour cost was 40 per cent greater than that of hours transferred out, records of these transfers in terms of cost, all that are to be found in the factory's journal vouchers, are not adequate, and have to be supplemented by a sampling of the payroll for average rates per hour of different groups of workers.

Inconsistency in the definition of ' direct ' is the main source of inconsistency in the figures for total usages of direct labour, and it quite overshadows a further lack of agreement as to what constitutes cost.[1] Although in no factory did ' cost ' mean full factor cost, there was only one source of inconsistency—and that a minor one—in the definitions of cost, concerning extra payments for shiftworking, and again attributable to a difference in the system of payment.

Actually we decided to substitute for labour cost as defined by factories its full factor cost[2] in order to facilitate the addition of labour and non-labour inputs. The change makes little difference to comparative measure of direct labour productivity as between these factories, as in all three direct labour cost as defined happened to constitute between 87 and 89 per cent of its full factor cost in the particular period chosen for detailed study. This was probably luck; for in the comparisons of single factories over time the distinction between the two kinds of productivity measures was by no means unimportant. In one, for instance, the temporary suspension of shift and overtime working in the slump of 1952–3 reduced the effective cost per hour of labour (after adjustment for changes in wage-levels) by as much as 4½ per cent below its level in the boom of early 1952.

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[1] Hours worked are consistently defined; but in records of employment there are inconsistencies over the treatment of absentees.

[2] Other than payments in kind. Possibly these should be included; but it is dubious how far a loss on the canteen—the main form of payment in kind in these factories—can usefully be regarded as a component in the reward of labour without taking into account the success with which the canteen is run.

Cost Accounting and Detailed Comparisons of Labour Usage

So far we have been discussing problems that arise in obtaining comparable figures for *total* direct labour usage in different factories; but our set of measures requires figures for the usage of direct labour on individual motors, which have to be derived from the cost accounting records. These records are also the only readily available ones that permit detailed analysis of the use of direct labour on particular operations or in particular manufacturing sections. Our initial hope that it would prove possible from the payroll or linked records to obtain comparable figures in all factories for usage of direct labour in separate manufacturing sections was not realised. Although in all three factories the payroll appeared to be ordered in such a way as to permit the calculation of such figures, investigation revealed that such figures would be too unreliable to be useful. Order on the payroll is determined by the individual's clock number, which does correspond to place of work; but clock numbers are not usually revised when workers transfer, temporarily or permanently, to other sections, and records of such transfers exist only in the timeworking factory, in which they have to be collected because they are required for purposes of cost accounting. So we have to rely on the cost accounting records both in the computation of overall measures and in any detailed investigations into the reason for any differences disclosed by the overall measures.[1] We must therefore ask how far these records are comparable in detail, even though one may hope that most of the effects of specific incomparabilities at a detailed level will cancel out on aggregation.

It is convenient to consider the problems arising in detailed comparison first. Clearly direct labour costs in cost accounting records will not be consistently defined in factories with differing definitions of direct labour *in toto*; but it would be legitimate to hope that inconsistency in the former could be roughly eliminated by applying to every direct labour figure in the cost accounting records in one factory a single uniform correcting factor. Suppose we had found that in factory A total direct labour usage defined in such a way as to be consistent with definitions at B would have been $L'^{(A)}$, as against the actual figure in A's records of $L^{(A)}$, we might then hope that the expression

$$\frac{L'^{(A)}}{L^{(A)}} \times l_r^{(A)}$$

would prove to be roughly comparable with the unadjusted $l_r^{(B)}$ found in factory B's cost accounting records. (The l's^r as before refer to direct labour usages on the rth type of motor; but the argument also applies to the detailed usages on particular operations.)

The first objection to this procedure is obvious but academic. If, for instance, $L^{(A)}$ includes re-operation work and $L^{(B)}$ does not, the use of a uniform factor is only correct if the proportion of re-operation work does not vary between types of motor. This is known to be untrue. But, since there exists no comprehensive information concerning the extent of re-operation on different types of motor, the most that can be done is to exercise care in interpretation.

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[1] In a special study of productivity and efficiency in a single small section, we were able in two factories, but not in the third, to use other records; but the work involved was such as to prevent any general extension to every section.

The second objection is far more important. Unlike the first it is not really a matter of consistency between factories but of inaccuracy within factories. Because of the way direct labour costs are calculated in each factory it is not at all difficult to show that there are systematic elements of over- and under-costing of particular kinds of operation, the size of which certainly surprised us. For instance, in one factory certain kinds of operation are regularly over-costed by a factor of about 25 per cent, and other kinds under-costed by 20 per cent. In another, the same degree of systematic inaccuracy is found, but with the difference that operations overcosted in the former are usually undercosted in the latter. So, even after adjustment for inconsistencies in the meaning of direct labour *in toto*, for some operations the real labour cost in the former will only be higher than in the latter if the apparent cost is over 50 per cent higher, the reverse relation applying for other operations. Since this is a difference far larger than one would expect to find at all generally between operations performed by similar means, its consequences for detailed analysis cannot be over-stressed.

First, let us see how these inaccuracies arise. Fundamentally they are due to the fact that there are two measures of labour usage—hours and pay—whose ratio varies from worker to worker, and therefore from operation to operation. The particular form they take depends on the detailed technique of cost accounting in use, and, as usual, the main determinant of practice is convenience. In each factory the cost accountant's job is to devise a technique for calculating costs from the records required to calculate the payroll, and again, therefore, different practices follow from different systems of payments. In a purely time-working factory there are no suitable records for labour cost accounting, since for the payroll no information need be collected about the jobs on which workers were engaged, and any costing system requires the collection of additional information. The technique used in the factory we studied is to split the factory and the payroll up into a large number of small manufacturing sections, so that for each section the total labour cost (and, if required, also the total hours worked) is known. For each section, there are available detailed inspection returns, so that all that is necessary to the computation of costs is to allocate the sectional costs among the products (typically particular components) shown in the inspection returns. The allocation is based on expected times as determined from time-study of the operations required for each product. This last step is at best a rough one; but, in spite of its obvious inadequacies, we have no doubt that the costing system in this factory led to rather more accurate relativities as between motors than did the more detailed techniques in use in either of the other two.[1]

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[1] This is not to say that it is a better technique, as costing individual products is only one purpose of cost accounting. The other systems probably lead to more accurate figures for the cost of direct labour incorporated into final output, or into work-in-progress, the main figures required for purposes of financial control.

In the pieceworking factory the obvious record for cost accounting is the piecework ticket, recording the operation done and its cost, and in this factory what is computed accurately is the piecework cost of any motor. Its total direct labour cost is obtained by adding on a fixed percentage corresponding to the average relationship between direct labour cost *in toto* and the total piecework cost of operations (other than those covered by waste tickets.)

In the ' mixed ' factory, one could obtain much more accurate detailed figures if so desired, as for each operation actual performance is month by month compared with standard. But in practice it is convenient to rely on the ' standard ' cost of operations and motors, as the use of these involves much less collection of figures. Before the start of each financial year an extensive system of standards is laid down, which are intended to be realistic targets for the average performance in the forthcoming year, and the whole accounting system is designed to compare actual performance with standard performance. Since no factory has much control over the prices or the wage-rates it has to pay, primary emphasis is laid on the physical targets, and, in particular, on the target hours set for each operation, simple average rates per hour being used for converting these hours into target costs.

So in each factory there is a different basic unit of account for direct labour. In the time-working factory it is roughly a penny of direct labour pay, in the piece-working factory it is a penny of piecework pay, and in the mixed factory it is a standard hour, and it is in respect of these units alone that the cost accounting records are accurate in detail. Let us consider two illustrations of the effect of this, one concerned with the sex of operative, and the other with his personal rate of work.

In all three factories women are, on average, paid about 30 per cent less per hour than men of the same skill grading. So in a cost accounting system based on hours without regard to sex, as in the mixed factory, operations done by women will be substantially overcosted, and those done by men undercosted. In the pieceworking factory, the opposite relation will prevail, since, under the national agreements for the engineering industry, the sex differential is confined to piecework payments. All adult semi-skilled pieceworkers receive the same time-rate per hour,[1] and so time payments form a higher proportion of total payments for women than for men (roughly one-half as against one-third). So in this factory operations done by women will be undercosted, and those done by men overcosted, the extent of the bias being roughly of the same order of magnitude as in the costing system based on hours. In the purely time-working factory, the use of work-study times as weights also leads to some bias; but it is markedly less there as many sections are predominantly of one or other sex.

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[1] Juveniles, on the other hand, do not; and one minor difficulty is associated with the fact that, while on average the ratio of time to piece payments for adult males and juveniles is much the same, boys' and women's piece-rates are much the same. As the factory concerned was having difficulty in obtaining all the boys it wished to employ, it sometimes happened that jobs classified as boys' jobs were in fact done by women at a higher total cost but with no extra piecework cost and therefore no record to indicate this fact.

This relation between sex of operative and over- and under-costing is the main source of large inaccuracies for particular operations. Correcting for it requires a considerable amount of detailed work, since the sex of operative is not an item of information normally shown in the cost accounting records. But since usually the sex can be inferred, crude adjustments can normally be made.

The second illustration, concerning personal rates of work, though rather less dramatic, is fundamentally more intractable. All cost accounting systems —implicitly or explicitly—at some stage involve assumptions about the relative rates of work on different types of operation. In the time-working factory these arise when it is assumed that, as between operations in the same section, costs can be apportioned according to time-studies. As a result, operations done relatively slowly in relation to their required times as determined by time-study will be undercosted in relation to others done in the same section, but not in relation to those done in different sections. This can have some odd effects. For instance, two common types of motor used in household equipment are split-phase high-torque motors and capacitor motors. In 1952, the latter were in fairly high demand and so were manufactured on the more standardised line of the two in this factory. But by the end of 1953 a declining demand for such motors and a growing demand for the simpler high-torque motors had led to their manufacture being transferred to the less standardised line. The result was a sharp rise of about 30 per cent in the apparent labour cost of capacitor motors and a rather smaller fall, of about 10 per cent, in that of high-torque motors. Some of this change was a real one, corresponding to the fact that the rate of work on the less standardised line was lower for all types of motor. But some of it was undoubtedly merely an effect of the system of cost accounting; for, as between operations done in the same section, apportionment of cost according to time-study is almost certain to lead to an overcosting of those operations done on the largest scale. So, in 1952, when capacitor motors were manufactured in the same section as the far more numerous high-torque motors, they were undercosted; but by the end of 1953, when they were being made in a section where most other types of motor were made on an even smaller scale, they were overcosted. So a careless reading of cost accounting figures can give a quite wrong impression of the sources of rising productivity. From the figures alone one would be inclined to deduce that *all* major improvements in productivity were confined to the manufacture of high-torque motors, and that they were therefore wholly the result of changes in techniques, organisation and labour supply specific to that manufacture. But in reality some all-round improvements in productivity have been masked by the system of cost accounting.

In factories with incentive schemes the relations are more complex. In the pieceworking factory, since piecework payments only constitute a part of total pay, a rising rate of work will lead to a declining total labour cost per piece, and so operations done relatively fast will be overcosted. Moreover, since piece-rates once fixed are not easily altered, there will usually be some operations with ' looser ' piece-rates than others, and these too will be overcosted. In effect, therefore, any operation in which the rate of work is relatively low in relation to the ' normal ' time implied in the piece-rate will be overcosted.

In the mixed factory, the relations are still more complex, because for each operation there are two postulated times—the ' normal ' on which bonus payments are based, and the usually much shorter ' target ' used in costing. Up to the minimum rate of work implied in the ' norms ' the pay per hour for an individual worker is steady, and the pay per piece falls; above that minimum rate the pay per piece falls only slowly, and the pay per hour rises. So there is no simple relation between cost and hours. Then there are some complications associated with the relations between target hours and normal hours, deviation here occurring both because of the factor of loose ' norms ' mentioned for the other factory, and because in setting targets, but not in setting ' norms ', detail is in some instances sacrificed. Target hours are occasionally averages over rather similar operations required on different motors, which would according to the ' norms ' be expected to take rather different times. Nor, of course, are target hours an accurate guide to actual hours on particular operations.[1] We do not pretend to be able to state exactly what bias results from all this, beyond the comment that the less common, and probably also the more awkward, motors seem likely to be undercosted; but that there are elements of bias associated with varying rates of work, is undeniable.

The implications of these varied relationships between rates of work and accuracy in costing are serious for our kind of study. In every factory the recorded cost of an operation is a kind of mixture between what it actually cost and what it 'ought' to have cost according to some predetermined norm or target. The mixture varies from factory to factory according to the peculiarities of its wages system; and it is usually very difficult to discover precisely what is being compared when cost accounting records are used for detailed comparisons. Of course, they have to be so used; but the extent of possible error for particular operations is such that at best what the cost accounting records permit—and that only after adjustment both for global differences in the definition of direct labour and for effects associated with sex of operative—are a very rough comparison of costs on individual operations, much the same conclusion as we reached earlier about detailed comparisons based on direct material costs. Again what is most likely to be revealed from such detailed comparisons are the major sources of difference. These may sometimes be those associated with differing rates of work on operations performed in essentially similar ways, but it seems rather more likely that they will be those associated with differences in design, equipment, techniques or organisation. So cost accounting records used in this way seem likely to reveal much about many important aspects of direct labour productivity, but comparatively little about the one aspect most commonly thought of in this context, the rates of work achieved by operatives.

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[1] A striking illustration of this is to be found in an American publication, concerned with the industry we are studying. After a detailed list of target hours for every operation required to make a motor in one factory, a note is appended at the end, saying that on average the targets were exceeded by 30 per cent. (*Bureau of Labour Statistics Report No. 23. Fractional Horsepower Motors*, 1951).

Overall Measures of Direct Labour Productivity

Our final expression for comparative direct labour productivity on A's output was

$$\frac{\sum_r n_r^{(A)} l_r^{(B)}}{L^{(A)}} \Big/ \frac{\sum_r n_r^{(B)} l_r^{(B)}}{L^{(B)}}$$

Clearly in computing this expression we have to standardise the meaning of the L's, the total figures for the usage of direct labour, in order to achieve even *prima facie* comparability; but, as for individual motors the direct labour costs from only one factory appear in this expression, and even then only as weights in output measures, it is legitimate to hope that standardisation can be confined to the L's; for errors and inconsistencies matter only if they are correlated with differences between the compositions of output in different factories. In order to see how important such inaccuracies were likely to be in practice, we carried out some check calculations in one factory, the pieceworking factory. We selected a list of twenty motors, and for nearly every operation required to make each motor, we calculated two new figures. One was an estimate of the actual time taken to do each individual operation, and the other of the sum of the time and piece payments made to the operative for this time. (Premium payments were not included). Both estimates were derived by sampling payrolls in order to determine, for as small groups as could be separately identified, both the average relation between time and piece payments and the average piecework earning per hour. The resulting estimates for the usage of direct labour on a few of the selected motors are shown in Table II, (p. 172) each figure being expressed as a percentage of the corresponding figure for the commonest motor.

At first glance the results are highly encouraging. There are no major differences between alternative relatives because on taking a sum over all the operations required to make a motor one eliminates most of the effects associated with sex of operative. Some residual effects remain. Motor D, which is an electrically-complex motor requiring many manual operations of a kind mostly done by women, appears on the cost accounting records to be cheaper than motor E, a mechanically-complex motor requiring much machining work of a kind mostly done by men, but is in terms of total labour cost rather more expensive. As a guide to relative times on different motors the cost accounting records are definitely less reliable, a comment of relevance to comparisons between this factory and the mixed factory, where the hour is the basic unit of cost accounting.

TABLE II

Direct Labour Usages on Individual Motors in one Factory

(Motor A=100)

Motor	Costs as shown in cost accounts (i.e. piece-work cost)	Estimated total cost	Estimated time taken	Ratios	
				Col. 2 / Col. 1	Col. 3 / Col. 1
A	100	100	100	1	1
B	109	110	110	1.01	1.01
C	130	134	137	1.03	1.05
D	153	163	174	1.07	1.14
E	163	158	152	.97	.93
Weighted average of B to E and similar motors	126.7	128.4	129.0	1.01	1.02

Note. Motor A is a very common motor, whose manufacture takes place mainly on a segregated line. B is a fairly common small motor, and C a less common large one, both very similar mechanically and electrically to A. D is a motor of electrically complex design, and E of mechanically complex design. Motors B to E are all manufactured on the same line, and for the weighted average the weights have been chosen so as to reflect all output from this line.

The further process of averaging over all motors made on the same line as motors B to E virtually eliminated any residual effects. Such motors are on average undercosted in relation to the commonest motor, A; but the undercosting is so slight as to seem unimportant, and we were therefore somewhat surprised to find that analogous effects did appear to matter in inter-factory comparisons.

Output in the mixed factory includes relatively fewer motors corresponding to type A, and relatively more of motors of the types made on the same line as motors B to E, and, when we used the figures in the table to calculate what direct labour would have been used in the pieceworking factory to make an output equivalent in composition to that made in the mixed factory, we found that it did matter which set of relatives was used. Use of the first column of figures in Table II, *i.e.* of the pieceworking factory's unadjusted cost accounting records, would suggest that in making this equivalent output the pieceworking factory would have had to pay out 7½ per cent more in piecework payments per motor than it actually paid out on its own output; but use of the third column of figures would suggest that time taken per motor would have risen by 10 per cent. The second column of figures leads to an intermediate figure of 8½ per cent. So, if we follow the easy course of using the first column of figures, our estimate of the effect of the compositional difference in output would have an error of about 1 percentage point in 8½ in a comparative measure of direct labour *costs* per equivalent motor—an error too small to matter. If, on the other hand, we were to use them as a guide to a comparative measure in terms of direct labour *hours* per equivalent motor, the error would be rather larger at 2½ percentage points in 10. Since in the mixed factory the unit of cost accounting is the hour, we have to expect that use of its cost accounting records might lead to errors of a similar size in comparing productivity on making the pieceworking factory's output, but with the difference that in this case the more accurate measure would be the one in terms of direct labour hours per motor. So, the effects of inaccuracies and inconsistencies in cost accounting records are not insignificant in relation to the measured size of the compositional differences between outputs in the two factories, although they are not so serious as to make estimates based on their use less reliable than ones in which compositional differences are entirely ignored, with productivity measured in terms of costs or hours per motor regardless of type.

However, at this stage we should recall our earlier theoretical discussion of the assumptions made in our framework of measures. We commented then that it would often be implausible to assume that, in a change of output composition, usages on individual motors would not alter. The compositional differences between outputs in the two factories are of a kind to make this comment particularly cogent; for the lesser importance of the commonest motors in output at the mixed factory means that, if it had to produce an equivalent output, the pieceworking factory would be forced to re-allocate manufacture between lines, with at any rate some consequences for the rates of work on different motors. So it would be rather absurd to attach much significance to errors in overall measures associated with variations in the rate of work between lines, and in this context the specific sources of inaccuracy and inconsistency in the costing of individual motors are unimportant. Their importance lies almost entirely in the barriers they raise to detailed analysis; for often they make it extraordinarily hard to discover on which motors—and still more on which operations—productivity is relatively high and so to discover, not only which of two factories is the more productive, but also—and that is our main aim—the main reasons why. So we can derive only limited satisfaction from the fact that overall the specific sources of error appear unimportant; for, although in some kinds of enquiry this might mean they could be ignored, in our kind of detailed study it means merely that the analysis of errors can be postponed until one reaches the stage of detailed investigation of sources of difference.

Overheads in General

For overhead inputs, there are no detailed figures to be found in the cost accounting records. Nor, in general, are there any other detailed figures that would permit one to estimate overhead usage on individual types of motors, even for those overheads for which theoretically such figures might exist. So for overhead inputs the only possible type of comparison that can be made on a comprehensive basis is one relating to output as a whole. The treatment of overheads in cost accounting records suggests that we should measure the productivity for any particular type of overhead by the expression

$$\frac{\sum_r n_r^{(A)} l_r^{(B)}}{\sum_r n_r^{(B)} l_r^{(B)}} \bigg/ \frac{O^{(A)}}{O^{(B)}},$$

(or by the corresponding expression with A and B interchanged), in which the O's refer to total usages of particular types of overhead.[1] So in the measurement of overhead productivities two separate issues arise—the measurement of the O's and the practical implications of using direct labour figures as weights for individual motors.

For the measurement of the O's we used as our basic record each factory's monthly account. The first main task was to standardise these accounts so that each item had a similar meaning in each factory, and the second was to link the costs shown in each account to any available physical figures for overheads, with of course special emphasis on figures for hours of work and for employment. In these twin tasks the problems that arise are mostly of a rather obvious kind. Factories do not employ standardised definitions for items in overheads, nor when terms appear similar in meaning, are the means of computation employed the same. Many of the differences can be traced back to the practices concerning the charging-out of direct labour to other accounts. Another typical source of difference is that in techniques for computing maintenance costs. In one factory, only the immediate material and labour costs of specific maintenance jobs are charged; in another, an addition is made to cover the salaries of chargehands supervising maintenance workers; and, in the third, a much larger addition is made to cover all the general expenses of the maintenance department. As with direct labour consistency between factories can be achieved only by standardising on the simplest definitions, and this involves a full unscrambling of the accounting systems. And, again, much of this unscrambling has to be done even in comparisons of a single factory over time, as the linking of costs in the accounts to physical records proved to be an essential stage in correcting for price and wage changes.[2] Since an account of all the manifold problems that arise would be both tedious and repetitive, we shall confine our comments to one problem of rather more general interest—that of capital inputs.

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[1] Again this is an over-simplification. Actually, if we followed the treatment suggested in the cost accounting records the l_r's would in two factories be replaced by expressions of the form $(\lambda l_r + \mu m_r)$, where the m_r's refer to direct material usages. The second term would be small in relation to the first; but it would differ from factory to factory, owing to differences in accounting practice rather than to any real differences. Of course, there is a case for using such weighted averages of labour and material, with weights uniform as between factories but not as between types of overhead. The work of planning departments, for instance, includes that of arranging for the supply of required materials, and the load of work there per motor must be expected to rise as the complexity of material requirements per motor rises, though not of course necessarily *pro rata* to direct material cost. But, in the absence of specific information relevant to the calculation of the weights λ and μ, the introduction of weighted averages would serve to complicate task of analysis for the sake of a largely spurious added air of accuracy. But it is, of course, true that measures of productivity for types of overhead in which a theoretical case could be made for a relatively heavy weight for materials are more suspect than those for, say, the costs of labour supervision.

[2] In the context of price-correction emphasis is often given to the likely effect of changing relative prices of inputs on their relative usage. We could find no sign in the figures that, over the short period of 2½ years covered in our study, these factories adjusted their behaviour to take account of such changes. So price-correction was for us no more than a tedious but necessary chore, and all that need be said is that the results appeared to be satisfactory.

Capital Inputs

One way of defining a capital input is as one that is joint between periods. In this rather wide sense, most overhead inputs are to some extent capital inputs, because expenditure on them is incurred in respect of goods or services that will continue to be useful in years to come. But in general there is little to be done about this problem in respect of inputs which are by convention charged currently, as there exists no comprehensive information that would permit the introduction of any depreciation system of charging.[1]

These comments are particularly relevant to development expenditure, the main item of which is the cost of planning, designing and making new tools. This is high in all three factories, and nowhere is it written off by normal depreciation techniques. In one it is all treated as a current cost of manufacture; and in the other two it is split, most of it being charged to special accounts, and written off in different ways. Probably the most satisfactory usage measures for tools would take the form of depreciation provisions, and in comparisons of a single factory over time we were able to incorporate such a system of charging. But, as between factories, figures comparable in definition can be obtained only on the basis of current expenditure, with obvious implications for their interpretation. Actually these implications are rather less serious than might be expected. Since so much work is done in the factories' own toolrooms, large fluctuations in work from year to year cannot easily be reconciled with the need to retain one's skilled planning, draughting and tool-making staff. This comment suggests that greater reliance should be placed on comparative figures relating to the labour costs of tooling alone (or even possibly to the labour costs of all work on equipment), as such figures may provide a better guide to the relative levels of ' normal ' expenditure, and thus to the relative levels that might have arisen from some technique of charging by depreciation provisions at replacement cost.

There is no sharp dividing line between development and capital expenditure. In all factories, for instance, tools bought together with machines from their makers are charged as capital, while in one factory at least some machinery made to the factory's own designs is charged as development. So there is about any measures of fixed capital some unavoidable imprecision that somewhat reduces the need to obtain exact comparability in the techniques of charging for those items which all factories charge through the medium of some depreciation provision. So one possibility would be to accept as adequate comparative measures of fixed capital usage depreciation as charged in factories' own accounts. The pragmatic case for this simple course is obvious; but the case against it is rather stronger and less theoretical than we would have suspected.

Consider a few figures from one factory. In 1954 the depreciation charge included in this factory's accounts for factory equipment was 67 per cent higher than in 1952; but, if the lives assumed by the accountant had been uniform in the two periods for similar types of equipment, the increase would have been only 32 per cent. However, if in both years accounting practice had been as in 1956, the rise would have been 72 per cent, as in the latter year it was decided to depreciate equipment as from its date of purchase, instead of merely in its first full year of ownership. Downie, when discussing depreciation in the context of productive efficiency, argues that the appropriate charge is what the firm says it is because the firm is the best judge; but one cannot have much faith in such an argument in the face of differences of this order of magnitude in one factory attributable solely to changes in accounting practice.[1] We can see some arguments for accepting either the 32 per cent or the 72 per cent, but not the 67 per cent shown in the accounts.

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[1] Rather similar problems arise over the holding of stocks of paper, overalls, coal, etc.

We would therefore conclude that, in order to obtain satisfactory financial measures of usage as between factories, a certain minimum of standardisation of accounting practice is essential to render more uniform the assumptions as to what is being depreciated and over what period. Although undoubtedly the actual lives of similar equipment do vary between factories, we doubt that it is reasonable to assume that this difference is accurately reflected in accounting practices at one specific point in time. As such standardisation cannot be easily achieved by adjusting accounting figures, there is on this ground alone a strong argument for using measures based on replacement costs.

TABLE III

Equipment at Original and Replacement Cost

(1952 accounting figures=100)

	Depreciated original cost		*Full replacement cost at 1954 prices*		*Replacement cost in 1954 as percentage of replacement cost in 1952*	*Ratio of replacement cost to depreciated original cost in 1954*
	1952	*1954*	*1952*	*1954*		
Capital value						
Machine and power tools	100	156	341	434	127	2.8
Shop appliances and equipment (including electrical)	100	138	234	314	134	2.3
Sum	100	151	312	401	129	2.7
Depreciation allowance	100	168	250	312	125	1.9

Note. The accounting figures used are those adjusted to give uniform accounting practice (see text). Figures of capital value refer to January 1952 and June 1954; figures of depreciation to the first halves of each year.

In the calculations we simply listed all the major items of equipment and obtained, by one means or another, an estimate for the replacement cost of each item in 1954. In calculating depreciation, we used straight-line depreciation techniques as in these one could avoid having to obtain details of ages, although ideally we have little doubt that diminishing balance techniques would be more appropriate. We did not investigate two other possibilities that are occasionally recommended, namely measurement by installed horse-power, or by valuations for insurance purposes. A third possibility, price correction of original costs, would have involved more work than the techniques actually used.

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[1] *Op. cit.*, p. 38.

We therefore also did some calculations on this latter basis for productive equipment in the same factory, and a few specimen figures are shown in Table III. Replacement cost accounting would suggest that the depreciation on installed equipment rose by roughly 25 per cent between 1952 and 1954. This contrasts with a 68 per cent rise[1] in the original cost measure, adjusted to achieve uniformity in accounting practice. The two thus diverge sharply to an extent that seems unlikely to reflect merely price-changes. In 1952 the replacement cost of machine and power tools at 1954 prices was 3.4 times the depreciated original cost and this must mean that at 1952 prices it would have been of the order of three times. Such a large ratio in a modern factory has to have a special explanation, and it is found in the history of this factory during the war years. Originally built and equipped by the Ministry of Supply for war work, at the end of the war the factory was leased and the equipment purchased second-hand from the Ministry at an agreed valuation. Much of this equipment was still in use in 1952, and one can scarcely feel that much service is done to a study of current efficiency by a measure based on the terms of a bargain struck in such special circumstances. In this particular factory this argument is a conclusive one in favour of replacement cost measures where they can be obtained, both for inter-temporal and for inter-factory comparisons.

We suspect that equally special circumstances would often be found in other comparisons. Often there will have been events in the past, distorting accounting figures, which force one to prefer replacement cost measures for depreciation on grounds unconnected with any rise in the costs of *new* machinery over time. Another illustration, probably commoner than the one discussed, is provided by another factory which revalued all its assets in 1951, with the result that its depreciation charges are not based on original cost. Thus, in our opinion, the case against using unadjusted accounting figures as measures of fixed capital usage, is primarily a pragmatic one based on the variety of special historical factors—including those that determine the timing of changes in accounting lives and other practices—thus brought into prominence.

This however does not alter the practical arguments for Downie's procedure. Firstly, it is so simple. Secondly, however much effort one expends, one cannot hope for a high coverage of fixed capital assets at replacement costs. What is the replacement cost of a factory building which would not, in fact, be put up to-day or even indeed if it might be? What is the replacement cost of a set of assets whose form was determined by the shortages of war? Any lengthy investigation of this kind of point would be foolish, and any serious attempt to improve on even the crudest of figures fruitless. So we shall adopt the rudimentary if honest procedure of filling out actual accounting figures with occasional replacement cost figures, and shall not seek to impose a single quite unattainable standard of measurement.

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[1] The coverage of this figure is slightly smaller than for the 72 per cent figure given earlier.

To this remark, one qualification should be made, concerning the addition of capital to current inputs in a measure of productive efficiency. In a time of inflation, and even more in the special circumstances found in this study, the use of replacement costs in place of accounting figures must greatly enhance the relative importance of a high productivity on capital inputs in measures of productive efficiency; and, in this context, adjustment even by the crudest of price indices is preferable to none.

Another issue that arises in this context is the cost of borrowing capital. Should measures of the usage of capital include some allowance for the fact that profits have to be earned on capital, and, if so, what kind of allowance? Our decision was to include an arbitrarily-chosen 5 per cent interest[1] charge on physical capital employed, fixed and working.[2] Actually in this study the decision turned out to be a matter of conceptual propriety rather than of practical import. For equipment the effects of the change to replacement cost accounting were far larger than the effects of including interest. Indeed the latter probably lay within the margin of error in the former. For land, buildings, and works, interest is much more important, and undoubtedly to omit it would be to be manifestly unfair in the contrast between the one factory which owned its premises and the others which rented them. However, as that is a field in which the chances of even roughly accurate comparative measurement are minimal, the inclusion of an interest charge turned out to be not very important even in that context.

Productivity Measurements for Overheads

On our system of measures, the productivity of any type of overhead is measured by the formula

$$\frac{\sum_r n_r^{(A)} l_r^{(B)}}{\sum_r n_r^{(B)} l_r^{(B)}} \bigg/ \frac{O^{(A)}}{O^{(B)}}$$

Another way of writing this formula is as

$$\frac{O^{(B)}}{n^{(BA)}} \div \frac{O^{(A)}}{n^{(A)}},$$

where $n^{(BA)}$ is given by the expression

$$n^{(BA)} = \sum_r n_r^{(B)} l_r^{(B)} \bigg/ \frac{\sum_r n_r^{(A)} l_r^{(B)}}{\sum_r n_r^{(A)}},$$

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[1] Downie (*op. cit.*, p. 40) argues in favour of a charge corresponding to the average rate of profit in the industry. As we do not know what this was, this procedure was not open to us. Nor is it a self-evidently better procedure than ours, as the rate of profit reflects both the 'riskiness' of the industry and the current 'efficiency' with which it uses capital. Here, as in so many other conceptual problems, it is hardly possible that any single indicator can be regarded as 'correct'.

[2] In practice, for equipment, we charged 2½ per cent on the full replacement cost of equipment, thereby making the simplifying assumption that asset ages were evenly spread within the lives used for calculation of depreciation at full replacement cost.

and is thus the number of motors of an output equivalent in composition to that made at A which could be made at B with an unchanged total usage of direct labour. Or, more simply, $n^{(BA)}$ is the number of motors in an output of A's composition similar in scale to output at B. As usual differences of scale *per se* between A and B are ignored in computing the measures of productivity. The advantage of this formulation is that it brings out clearly the assumption made in our measures. We are not asking ' What would be the overhead cost of some other output? ' Rather we ask ' How many motors of some other composition of output could probably be made without changing the overhead cost? '; and the assumption made in the measures is that any output which would require the same total usage of direct labour would also require the same total usage of each type of overhead.

For a really general overhead this assumption, though not necessarily accurate in any particular case, seems a reasonable enough one to make. For instance, in the case of factory heating, although an unchanged total usage of direct labour would not necessarily involve no change in total factory working hours, and although the latter would not necessarily involve no change in factory heating costs, both are plausible assumptions that can be accepted without further ado. But for most types of overhead there exist obvious reasons why one would expect certain kinds of change in output composition to alter the total usage of particular types of overhead even though they did not alter the total usage of direct labour, and it is these types that require discussion.

We shall confine our discussion to one type, the cost of productive equipment, which is in many ways the most difficult of all. Let us begin by considering some illustrative figures from the pieceworking factory. There, piecework tickets, which specify, by implication at any rate, the machines on which operations were done, can be used to provide some direct evidence as to the capital cost of particular operations. We took the same list of motors as before, and for each required operation we calculated a machine cost by multiplying the piecework cost for that operation by a measure of its effective capital intensity, as given by the estimated ratio over a period of six months of the depreciation charge at replacement prices for the machine used to the estimated total piecework cost paid out in respect of operations performed on it. On this basis, the capital intensity of individual operations varies from zero to over ten; but for individual motors as a whole the variation is, of course, much less marked. Machine cost per labour hour even for E, the most expensive motor in machinery, was only twice that on the cheapest motor, D.

A particular point to note about the costs of these two motors is that high and low machine costs per hour are associated with low and high piecework costs per hour respectively. This association is due to a marked association between sex of operative and intrinsic capital intensity of operation, the more expensive equipment being usually operated by men. But for motors B and C, and for the weighted average, this relation is reversed, and for them a higher

TABLE IV

Direct Labour and Machinery Usages on Individual Motors

Motor	*Direct labour cost as shown in cost accounts (i.e. piecework cost)*	*Estimated hours*	*Estimated machinery cost*	*Ratios*	
				$\frac{\text{Col. 2}}{\text{Col. 1}}$	$\frac{\text{Col. 3}}{\text{Col. 2}}$
A	100	100	100	1	1
B	109	110	119	1.01	1.08
C	130	137	146	1.05	1.07
D	153	174	125	1.14	.72
E	163	152	217	.93	1.43
Weighted av. of B to E and similar motors	126.7	129.0	138.4	1.02	1.07

Note. The different motors are as in Table II (p. 172), and the first two columns are repeated from that table. The average is again the best estimate for the average cost of *all* motors made on the same line as motors B to E.

machinery cost per hour is associated with a higher piecework cost per hour. The reason for this latter association is to be found in variations, not in the intrinsic capital intensity of operations, but in the rate of utilisation of machines. In our technique for estimating machine costs for individual motors, the whole depreciation charge for a machine is attributed to the operations performed on it, irrespective of the time it was actually in use; and so machine costs tend to be high for motors made on equipment which stands idle for much of the time either because it requires resetting or through lack of work. Both forms of idleness are likely to be associated with a high degree of mix in operations, as are, to a much lesser extent, the lower rates of work by operatives that for similar grades will lead to a lower level of piece work cost per hour.

The fact that a relationship attributable to varying rates of utilisation predominates on average over one attributable to variations in inherent capital intensities is for us most encouraging. Firstly, the most obvious reason for doubting the propriety of using direct labour figures to compute machinery productivity is the variation in intrinsic capital intensity from operation to operation. The analysis shows that this is less dangerous than might, in abstract, be feared, owing mainly, of course, to the fact that all motors require both machining and manual operations. Secondly, it gives grounds for suspecting that the measures based on machinery usages for individual motors are themselves likely to be inaccurate and therefore not necessarily any improvement on the simpler ones based on direct labour figures; for consider the dubious assumptions that have to be made in their computation.

In their calculation the costs of idle machine time are charged to the individual motors actually made on any particular machine. This seems reasonable enough, particularly for time taken up by re-setting. It is certainly a more realistic system of charging than one in which idle machine time is treated as a general factory overhead cost. But because idle time (including resetting time) is usually due to a lack of demand for a particular operation, the use of machine costs of this kind to compute the effects on machinery costs of changes in composition has serious disadvantages. For, in using them, we have to assume that the machine costs of individual motors would not alter, and therefore implicitly that the ratio of operational to non-operational time on particular machines would not alter. In particular, therefore, a measure of machine productivity based on such an assumption carries with it the implication that, if motors are of a kind that makes it likely that they will be made on equipment with a relatively low rate of utilisation, a shift in the composition of output towards such motors will increase machinery requirements, because the proportion of idle time as a whole will rise. Even for idle time attributable to resetting needs this is somewhat unplausible, since, if the output of motors previously made on a small scale rises, the amount of re-setting needed per motor for these motors will almost certainly fall. For idle machine time due to a lack of work it is even less plausible, since the change in output is one that will lead to more work for the idle machinery and so will automatically raise the utilisation of the under-utilised equipment. Thus, for machinery, the theoretical arguments concerning ' unfairness ' in our type of productivity measures are compelling, particularly as variations in the rate of utilisation appear to be the main reason why measures based on machinery figures would in this factory diverge from ones based on direct labour figures.

Of course, both types of measures involve major over-simplifications. In a multi-product factory where most machinery is used to make a variety of products, one cannot expect simple assumptions of the kind that have to be made in order to obtain any measures at all to lead to accurate results. But it is gratifying to find that, in this case, refinement of the measures through the collection of a large amount of detailed information concerning the way in which each machine is actually used does not lead to any marked improvement. Of course, if we wish to go on to detailed analysis of the sources of machine productivity, such detailed investigation would be essential. But, given the fact that it is not the common practice to record details of machine cost for individual motors, any comprehensive investigation is clearly impossible, and it is therefore important that one can by the straightforward use of direct labour figures as weights obtain overall measures of machinery productivity into which any special studies or speculative comments can be fitted. They are far from perfect measures; but they are much better than might be expected from the crudity of the underlying assumption, that the cost of equipment would not alter when the composition, but not the scale, of output altered.

This conclusion does not apply to all types of overhead. In particular, simple measures are likely to be false for those ancillary workers closest to the point of manufacture—the testers of motors and their components, and the setters of machinery, whose work-load must be expected to vary as the composition of output alters. But for most types of overheads—and in particular for the cost of the general salariat which in this industry is about two-fifths of the direct labour bill—it does seem that an adequate impression of productivity can be obtained by assuming the ratio of their usage to that of direct labour to be independent of the detailed composition of output.

To this encouraging conclusion some qualifications have to be made concerning the estimates of overheads attributable to products lying outside the comparable ranges of output. The analysis just given related solely to variation between motors of the same basic type, and not all motors from these factories can be so described. The figures were taken from the pieceworking factory to which this description was most applicable, where they referred to 97 per cent of output of new products and to about 93 per cent of all output including spares and repairs. In the two other factories the proportions of output within the comparable range were much smaller—70 per cent in the time-working factory and 25 per cent in the mixed. We would not conclude from our analysis that what proved true within an essentially similar range of products was necessarily true outside it. For instance, repair work manifestly requires less machinery than does the manufacture of new motors, as it includes so much disassembly, adjustment, and reassembly. Nevertheless, we often have to draw that conclusion without testing it; for, in the timeworking factory, essentially the same technique of using direct labour figures has to be used for estimating the overheads attributable to non-comparable output. Fortunately, in the mixed factory, where manufacture of comparable output is largely segregated into separate departments for which separate accounts are kept, the technique need be used only for the more general factory overheads which are joint between separate manufacturing lines.

This qualification about overheads on non-comparable output is really serious—perhaps the most serious of all those that have to be made about the figures available. Yet it is difficult to see how one can avoid such assumptions if one wants to measure anything useful about productive efficiency. It would not be very helpful, even if it were possible, to select factories manufacturing exactly the same range of products, since decisions as to the range to be made within a single factory (particularly in firms owning many factories) are decisions as relevant to any comprehensive concept of efficiency as are the more readily assessable ones. So we feel that it would be decidedly wrong to consider this qualification as solely one concerning the accuracy of available figures; for it is as much a qualification concerning the comparability of the jobs done in factories, and therefore concerning the whole of our approach in which factories are compared on the basis of their performances in respect of the products that they all make.

CONCLUSION

Our study concerns the efficiency of factories, and is an attempt, largely by detailed comparative measurement of rather similar factories, to elucidate its sources. Deliberately, we have at no stage in this article attempted to give a precise definition of efficiency; for we believe that, in practical studies, abstract discussions of the concept are likely to be fruitless. What instead we have done is to discuss the implications of a particular set of measures—the only set which gives much hope of identifying the sources, as well as the size, of differences in efficiency.

The set is far from perfect—conceptually and in practice. Both kinds of imperfections have fairly simple sources, simple enough indeed for either alone not to constitute too severe a difficulty. It is their simultaneous existence that constitutes the real difficulty—a difficulty that can often take the form of an uncertainty as to whether a failure to measure efficiency differences is the result of a lack of adequate or comparable information, or of the existence of a degree of specialisation that makes it virtually meaningless to think of efficiency in the kind of way involved in our approach.

The conceptual imperfections arise as follows. One way—perhaps the basic way—of thinking of efficiency is as a statement about performance that is in essence a comparison between the value of the results achieved and the value of the resources used. That is not the way implicit in our approach. We have not set out to measure the value of the results; for that subject lies right outside our chosen field of study. The fact that a particular set of values is implicit in our approach is essentially irrelevant; for the set that is implicit, valuation of different motors according to relative costs in a single factory, is self-evidently rather a poor set, and was introduced into the discussion solely to illustrate the existence of alternative ways of thinking of efficiency, and therefore of some aspects of factory performance which were of a kind that could not be assessed on our type of analysis.

What then is our concept of efficiency? Essentially we take the statement about performance, subdivide it into two parts, and investigate only one part. It sounds sense to suggest that factory performance can be good either because the value of the results is high in relation to the difficulty of the job done or because a difficult job has been done with few resources. Nevertheless it is an assumption that this distinction can meaningfully be made.

That this should be so is straightforward enough. Only if two factories are performing the same task do no serious doubts arise. Even then, of course, there are some conceptual problems concerning the meaning of 'fewer resources' when different resources are used; but in a detailed study these are best approached through an investigation of the alternative indicators which are available. In practice, the decision to compute such indicators does not affect the form of the measures used.[1] But, if factories perform different tasks, then the identification of efficiency requires a separation between the elements in the performance that arise because the task is performed with differing efficiency and those that arise because the tasks are different. Since, for instance, the layout of a line is a reflection both of ideas concerning the best means of organising manufacture and of expectations concerning the kind of output to be made on it, there is no reason for supposing that these elements can be separately identified even in principle. All one can do is to introduce some arbitrary working rules of independence of effects, which one knows must be over-simplifications of reality.

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[1] Theoretically this is not so. For instance, a labour productivity measure in which labour usage is measured in terms of hours theoretically requires a different weighting of the importance of different motors in output to that appropriate to measurement in terms of cost. In practice, however, the distinction is academic, as in each factory there is only one set of figures for the relative usages of direct labour on different motors, which has to be used for both types of measure.

In this article we have given particular prominence to one of these rules —that concerning the independence of the usages of inputs on individual motors from the composition of output. We have given far less prominence to some other equally important ones—for instance, that concerned in our decision to ignore the effects of differences in the range of output in measuring efficiency over the comparable range. The reason is simple. In the first case, we are dealing with something the effects of which can be investigated, because the assumption leads to two measures, the sources of whose divergence can be analysed; but, in the second case, we have to make an untestable assumption, whose content one knows to be somewhat false, but whose significance can only be argued by analogy from the testable case.

We therefore wish again to stress the fundamental word ' provisional ' which we have used several times to describe our set of measures. Our measures of productivities are all provisional in the sense that it is a provisional assumption that the jobs done by these factories are sufficiently comparable to permit meaningful statements to be made about their comparative efficiency.

All this can be put in rather simpler terms. On our system, the test of efficiency over the comparable range of output is a stringent one; for, before we describe one factory as definitely more efficient than another, we require that it should use fewer resources than another in making an output equivalent in composition to that actually made in that other factory. But common sense would suggest that in assessing comparative efficiency we should take some account of the historical factors that make it inherently unlikely that this is a fair test, by trying in some way to abstract from the history, and to assess, not what resources the factory as it is would have used on this other output, but rather, what resources it would have used if this other output had been one it expected to have to produce. The test is far too vague to be given quantitative form; for the only evidence one has about likely performance on some other output has to be derived from the details of current performance on its own output.

Even then the assessment we have to use in our measures is rather unsatisfactory. In practise we use, not merely an unfairly stringent test, but also one incorporating unrealistic assumptions that fail to take account even of changes that would almost certainly be made, so that our measures are even more unfair than is merely inherent in the whole concept of comparing factories on the basis of their hypothetical performance on tasks they were not asked to do.

But, as we said earlier, conceptual difficulties alone are not in themselves too serious, if they can be separated from the more mundane ones that arise from lack of appropriate information. Often this is just what cannot be done. Here the trouble is not a lack of information *per se*. All the factories we studied kept a very large number of records out of which a reasonably comprehensive picture of their activities can be built up in their own terms; and therefore comprehensive inter-temporal studies of efficiency in a single factory are reasonably straightforward. Nor does the trouble stem solely from the fact that most information is incomparable in content as between factories, though this is serious enough. The incomparability in accounting terms and procedures is not the result of differences in the views of accountants as to the most illuminating forms of record to keep, but is rather the natural result of different systems of payment, with the corollary, not only that terms are unstandardised in definition, but also that the records do not exist which would permit their standardisation in any detail. Certainly, in our original plans we did not take sufficient account of the likely extent of this incomparability, which forced us to abandon our original plan for a two-stage project in which the first stage of summary measurement would have been followed by detailed investigation of significant differences so revealed.

The core of the trouble is undoubtedly direct labour. Incomparability is rife for all inputs other than direct materials; but only for direct labour is it of crucial importance, and only for direct labour did it, or would it, come as much of a surprise. To discover, for instance, that accounting figures for machinery are unreliable as comparative indicators of capital usage is no new discovery; nor is it unexpected that accurate measures at replacement cost cannot easily be constructed. At best all we had ever hoped for in such respects was to find a rather crude comparability of figures that might nevertheless be suggestive of interesting conclusions. Indeed in one way our measures are better than we had expected. Although it is obviously rather dangerous to calculate overhead productivities as if the ratio between the total usage of any particular type of overhead and total direct labour usage were independent of the composition of output, on investigation the procedure turns out to be much better than might be feared. Obviously, the lack of detailed information concerning the usage of particular overheads means that any analysis of the reason for differences in particular overhead productivities has to be rather speculative, except where one can make special intensive studies; but at any rate there does seem to be some framework of general measures into which both the speculation and the special studies can be fitted.

For direct labour we hoped for much more than this; for we had expected to calculate not merely satisfactory measures for overall direct labour productivity, but also a whole framework of subsidary measures that would enable its sources to be analysed in detail. But that is just what the cost accounting records do not permit. The job of a cost accountant is to devise a reasonably satisfactory, yet economical, means of calculating costs of specific operations so that, when these are used either for pricing or for cost control, the errors should not be large. For him the cost of a specific operation is not particularly important, and considerable inaccuracy in relative costs is compatible with reasonable accuracy in overall results. So when one tries to use the records for a purpose for which they were not intended, one must expect to run into trouble—minor when the records are used to compute overall comparative measures, particularly of course in comparisons in a single factory, but growing steadily larger as the attempted comparisions become more detailed. At the overall level the inaccuracies are insignificant in relation to the conceptual difficulties associated with the chosen framework; but for individual motors, and still more for individual operations, the chances of drawing wrong conclusions rapidly increase. For particular groups of operations, a really detailed investigation may permit the calculation of satisfactory comparable figures, and we did carry out such an investigation for the labour used in the manufacture of a single type of component. But, in general, one cannot hope to unravel for all operations the mixture between actual and assumed usages that has gone into the calculation of direct labour costs in the cost accounting records of different factories.

In one particular aspect of this lack of detailed comparability is of outstanding importance, that concerning rates of work. For us, and we suspect for many, this would be the aspect of a comparison between factories of peculiar interest, particularly in a multi-product factory where the need to vary the product makes the achievement of an even flow of work especially hard. Moreover it is of considerable importance in this particular comparison, as there is definite evidence of major differences in the type of direct labour used on similar work. But it is for just this aspect of direct labour productivity that the greatest difficulties of measurement exist. On the one hand, there is the lack of a sufficient comparability at the detailed level to permit one easily to draw conclusions about rates of work on individual operations done in similar ways; while, on the other hand, the process of separating out in overall measures this particular aspect of productivity is bound to be difficult in the presence of widespread *de facto* specialisation.

This fact is what gives importance to the study of direct materials. Originally we decided to include these in our study, partly in order to be comprehensive, but mainly because of the possibilities of important substitution effects—direct and indirect—between them and the inputs in which we were more interested. But the discovery that they are in fact the only inputs for which a reasonable degree of detailed comparability in records exists makes their study more important than we anticipated, as it is only for them that fairly clear lines can be drawn between the conceptual issues associated with the basic technique of measurement and the practical issues associated with the imperfections of the available information. So in our next article prominence will be given to this analysis of direct materials, as a preparation for the more interesting but far more difficult analysis of direct labour productivity.

In these last paragraphs, we have deliberately painted a rather gloomy picture; for, because we under-estimated the intense difficulties of calculating comparative measures between multi-product factories, we want to do our best to prevent others having similar illusions. But we should not suggest that no detailed comparisons are possible or that no conclusions can be drawn from them about sources of productivity and efficiency differences. What cannot emerge are simple conclusions or conclusions of a definitiveness that cannot be denied. But then it would in a way be naïf to expect such conclusions in comparisons between multi-product factories, all of reasonably high efficiency. If they choose different ways of doing their jobs, that in itself is evidence that there is unlikely to be any clearly best way of doing things; and, although in this article we have discussed mainly the difficulties that arise in computing comparative measures, it should not be forgotten that such measures are hard to compute primarily because the potential sources of efficiency in a multi-product factory are far more numerous than can possibly be fully covered by even the most elaborate system of records. The task of measurement is difficult because the job done in these factories is itself a task of great difficulty, and any simple set of measures can only misrepresent the complex reality of the manufacturing problem.

THE BENEFITS AND COSTS OF PRIVATE INVESTMENT FROM ABROAD: A THEORETICAL APPROACH[1]

By G. D. A. MacDougall

In the symposium on 'The Future of the Sterling Area', Bulletin, *November* 1959, *the question came up on more than one occasion whether it was wise for Britain to invest so much abroad. This is clearly an important question of economic policy which has perhaps received insufficient attention. The two articles which follow are theoretical discussions of some aspects of it. The first article in fact approaches the problem from the point of view of a country receiving capital. It discusses the benefits and costs to Australia of private investment from abroad. But though this paper is written with one country in mind, we felt that Sir Donald MacDougall's approach was extremely interesting in itself, and lent itself for adaptation to other cases. The article has already been published in the special issue of* The Economic Record *for March* 1960—*Essays in honour of Sir Douglas Copland. We are grateful to the Economic Society of Australia and New Zealand for permission to reprint it in* The Bulletin. The *second article is a dynamic approach to the problem from the British point of view.*

The Editors.

I

The benefits and costs of private investment from abroad are a matter of considerable importance for Australia. This paper suggests one possible method of analysing some general aspects of the problem. It is mainly theoretical and does not attempt to reach clear-cut practical conclusions. This would require much more factual analysis and consideration of many other aspects. Some of these were discussed by Professor Arndt in 'Overseas Borrowing—the New Model' (*Economic Record*, August 1957), an article which also deals with many of the points analysed below.

The analysis is for the most part static and thereby ignores certain dynamic considerations that may be important. It attempts to assess the difference made to the real income of Australia at a given moment of time by the presence of more or less foreign-owned private capital in the country, on the assumption that the economic forces involved have had time to work themselves out (the analysis is thus a long run one). For ease of exposition this is done by starting with a given situation and then considering the effects of an increase in the foreign-owned capital stock; the analysis could equally be applied to a reduction. The moment of time may be thought of as a number of years ahead, in which case we are considering the effects on Australian income at that time of a greater or smaller inflow of capital in the intervening period.

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[1] This article was written while the author was Visiting Professor of Economics and Finance at the Australian National University. I am grateful to several economists, including Professor T. W. Swan, Mr. H. P. Brown and Dr. W. E. G. Salter, for discussing these matters with me, and especially indebted to Dr. I. F. Pearce for his help.

We shall consider only relatively small changes in the stock of foreign capital. This simplifies the analysis and seems legitimate provided one is not looking too far ahead. For differences in capital inflow are then unlikely to make a large proportionate difference to the foreign capital stock or, *a fortiori*, to the total stock. It will be suggested later that, in real terms, the foreign private capital stock in Australia may have increased since the war by perhaps 6 per cent per annum on average. If this rate were increased or diminished by, say, one-half, it would make a difference of only around 15 per cent in the foreign capital stock in 5 years' time, and a much smaller percentage difference in the total stock—say 1½ per cent if we make a rough guess that the foreign-owned stock is of the order of one-tenth of the total;[1] certainly the great bulk of the capital is still owned by Australians.

We start with drastic assumptions. The main ones, which will be relaxed as the analysis proceeds, are:

(1) the government maintains 'full employment without over-employment' or, more generally, a constant degree of employment of Australian resources;
(2) no taxation;
(3) the size of the labour force is independent of the stock of foreign capital;
(4) the stock of Australian-owned capital is independent of the stock of foreign capital;
(5) no external economies;
(6) constant returns to scale;
(7) perfect competition;
(8) more or less investment from abroad has no effect on the terms of trade;
(9) it creates no difficulties for the balance of payments which can be adjusted smoothly, and without cost, as required;
(10) the increase in foreign capital considered does not require changes in Australian policy that themselves may involve a loss to Australia.

II

The line GK in Diagram I relates the physical capital stock in Australia to the physical marginal product of capital, given the amount of other factors of production, which we shall call 'labour'. Initially, the capital stock is AC, of which AB is owned by Australians and BC by non-Australians (called 'foreigners' hereafter). Since, on our assumptions, profits per unit of capital equal the marginal product of capital, total profits are FEBA on

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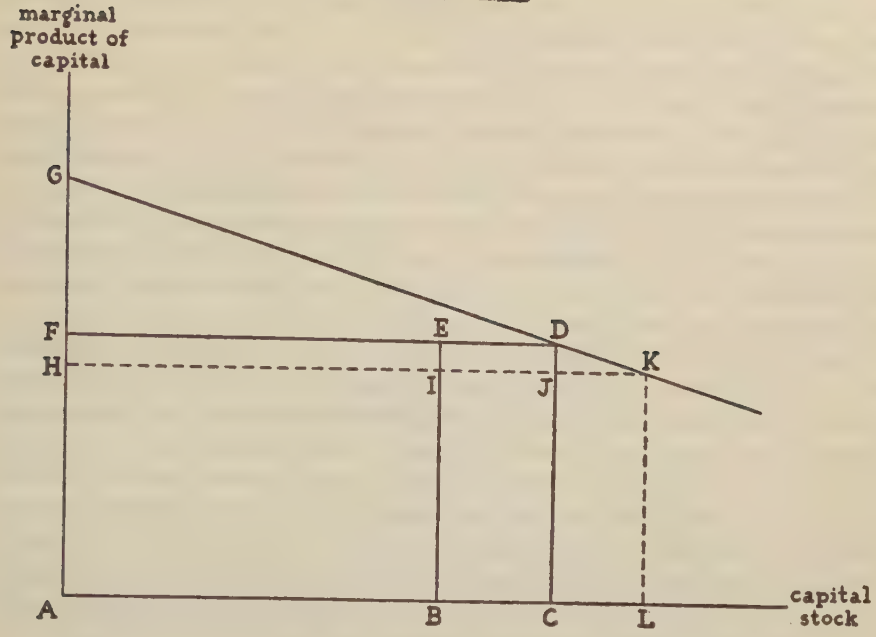
[1] This is only an illustrative order of magnitude based on various 'back-of-the-envelope' calculations. For the sake of exposition it will be used on several occasions but the general arguments would be unaffected if the true figure were substantially higher, say one-fifth, and true *a fortiori* if it were less than one-tenth.

It is hard to say whether the ratio of the *flow* of new foreign investment to total new investment since the war has been greater than the ratio of the *stocks*. The ratio of the flows has been quite high in certain sectors such as manufacturing.

Diagram I



Australian capital and EDCB on foreign capital. Output is GDCA so that labour gets GDF.[1]

Now suppose a small increase in foreign capital from BC to BL. Foreign profits become IKLB. The new foreign capital earns JKLC and the 'old' foreign capital loses EDJI because the marginal product of capital, and hence the profit rate, have fallen. Total foreign profits are almost certain to rise on balance because, for reasons to be given shortly, the 'elasticity of demand for foreign capital' (as we shall call the percentage increase in the stock of foreign capital associated with a one per cent fall in its marginal product) almost certainly exceeds unity.

Australian capitalists lose FEIH. Labour gains FDKH. Australia as a whole thus gains EDKI. Since DKJ is relatively small, Australia's gain is approximately EDJI which is the loss of income on the 'old' foreign capital. Australia does not, as is sometimes thought, gain the whole of FDJH, i.e. the whole of the increase in real wages resulting from labour's higher marginal productivity, but only a proportion corresponding to the ratio of foreign to total capital; the great bulk of labour's gain is merely a redistribution from Australian capitalists.

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[1] This assumes that labour could not produce any output in the absence of capital. If it could, such output should be added to the amounts shown for both total output (GDCA) and total real wages (GDF). Since the subsequent argument would be unaffected, we have retained our assumption for simplicity of exposition and to avoid the use of mathematics other than geometry. See also p. 194, n. 1, p. 196, n. 1 and p. 199, n. 1.

(Here, incidentally, we have one argument for restriction of foreign investment by the investing countries—which we shall call ' Britain '. Assuming no risk differential, British investors, if left to their own devices, equate the returns on home and foreign investments. But, while the marginal *national* (British) product on investment in Britain equals the private return, it falls short of this on investment in Australia to the extent of the reduction in profits on existing British investments there—EDJI in the diagram.[1] This loss of profits goes to Australian labour whereas the corresponding loss when there is more investment in Britain goes to British labour. If there is a difference in risk on investments in the two places—in either direction—the conclusion is unaffected provided British investors correctly evaluate the difference.)

Australia's gain (and Britain's loss) from more foreign investment in Australia is, however, unlikely to be at all large on our present assumptions. If total capital is of the order of 10 times foreign capital, the ' elasticity of demand ' for foreign capital will be about 10 times that for total capital (i.e. 10 times the elasticity of the curve GK at D)[2]; and this latter elasticity is itself likely to be considerable because the substitutability of capital for labour is probably fairly high in Australia. The ' elasticity of demand ' for foreign capital is thus likely to be high, so that EDJI will be small in relation to JKLC. In other words the great bulk of the extra output (approximately JKLC) will go to foreign capitalists; Australia's share will be small.

III

Now remove assumption (2) and allow for taxation. Suppose the rate of tax on foreign profits is t. This often approaches one-half where all profits are distributed and we shall, for simplicity, use this fraction as an illustrative order of magnitude, though it should be borne in mind that it is on the high side.[3] Australia now gains, in addition to EDJI, the tax on the net increase in foreign profits and this is likely to be a considerably more important gain. Put in another way, Australia now gains t(JKLC) plus, it is true, only (1—t) (EDJI) instead of EDJI, but this a relatively small matter.

Taxation is not shown in the diagram to avoid complicating it. The case where the extra foreign capital is induced by lowering the tax rate will be considered in section XI; it is ruled out at present by assumption (10).

(We now have a much more important argument for restriction of investment by ' Britain '. Double taxation agreements are complicated things, but for our present purpose it is probably legitimate to assume that the British Treasury gets only the excess (if any) of the British rate of tax over the Australian rate, after the Australian Treasury has levied its tax in full. Now, if the British tax rate is the higher, British investors (ignoring differences in risk) equate the returns after the *British* rate of tax on investments in the two places, which means that they also equate the *gross* returns (before tax). But, while the marginal *national* (British) product is the gross return on investment in Britain (since Britain gets the tax), it is the net return, after Australian tax, on investment in Australia,[1] and this may be little more than half as great. If the Australian tax rate is the higher, the difference between the marginal national products equals tax at the British rate; the marginal national (British) product on investment in Australia may still be only about half that on investment in Britain.[2] These asides about ' Britain ' do not, of course, constitute a full analysis of the pros and cons of invesment abroad from the point of view of investing countries.)

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[1] If ' Britain ' is only one of a number of foreign countries with capital in Australia, and invests an additional CL there, the loss on her existing investments will, of course, be less than EDJI; part of Australia's gain will be at the expense of the other foreign countries.

[2] If a 1 per cent change in the marginal product of capital is associated with a change of x per cent in total capital, it will be associated with a change of 10x per cent in foreign capital if Australian-owned capital is constant.

[3] If there is a tax on profits of 7s. 6d. in the £ plus a withholding tax of 15 per cent on dividends, the total rate of tax will be 47 per cent. In fact, something approaching this rate seems to be fairly common although some foreign profits are charged substantially less for various reasons; and if profits are undistributed the rate is also, of course, lower.

IV

Next remove assumption (3) and allow the size of the Australian labour force to be dependent on the amount of foreign capital. It is not unreasonable to suppose that immigration policy (and the supply of would-be immigrants) will be related in some way to the level of Australian incomes and these will be affected by the amount of foreign capital.

The gains from additional foreign capital so far described—there are more to come in later sections—will raise income per head if the labour force is not increased. It will thus be possible, if desired and if practicable, to increase population to some extent without reducing income per head below the ' initial ' level, by which we mean the level it would have attained in the absence of the extra foreign capital. (This could still, of course, be consistent with a rise in income per head over time). It is impossible to say how immigration policy might in practice be related to levels of income and thus, indirectly, to foreign investment, but some highly simplified illustrations may be helpful.

Suppose that the extra foreign capital increased total capital by 1 per cent (which would mean a 10 per cent increase in foreign capital if this were one-tenth of the total). If then the labour force were allowed to increase by 1 per

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[1] For simplicity of exposition we ignore here the reduction in profits on existing British investments in Australia discussed in the last section.

[2] Let r_a and r_b be the gross returns in Australia and Britain and t_a and t_b the rates of tax.
If $t_b > t_a$, British investors will make

$$r_b(1-t_b)=r_a[1-t_a-(t_b-t_a)]=r_a(1-t_b)$$

i.e. $$r_b=r_a=r \quad \text{(say)}.$$

The marginal national (British) product is r on investment in Britain but $r(1-t_a)$ on investment in Australia, the ratio of the latter to the former being $(1-t_a)$.

If $t_a > t_b$, British investors will make

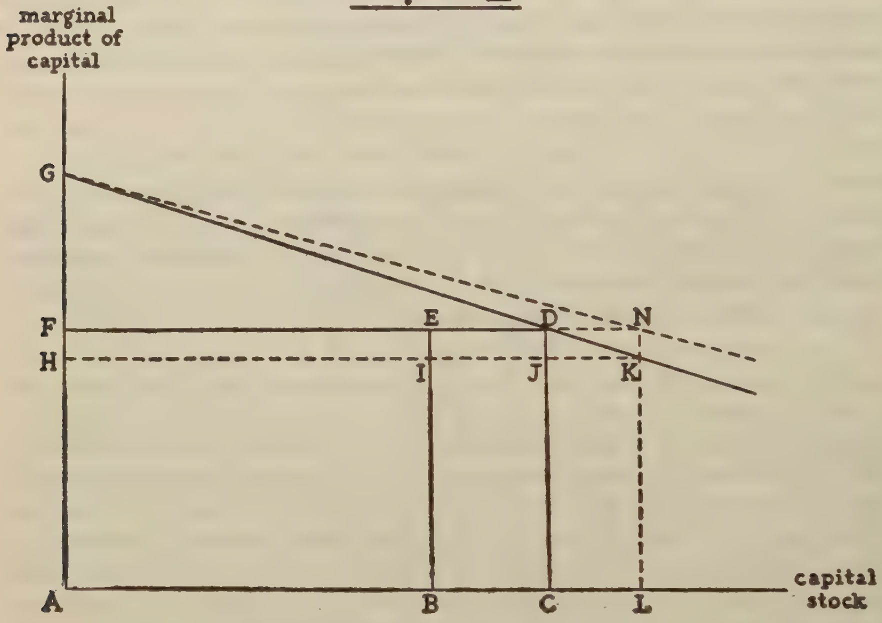
$$r_b(1-t_b)=r_a(1-t_a).$$

The marginal national (British) product is then r_b on investment in Britain but $r_a(1-t_a) = r_b(1-t_b)$ on investment in Australia, the ratio being $(1-t_b)$ which is still not much over one-half for many taxpayers.

cent there would, on our present assumptions, be an increase of 1 per cent in total output, total profits and total wages above the initial level; the wage rate would be reduced again to the initial level, the profit rate restored to the initial level. Assuming no taxation, and no change in the number of Australian capitalists, the average Australian worker (including the extra immigrants) and the average Australian capitalist would then be as well off as initially, i.e as they would have been had there been no increase in foreign capital and no consequential increase in the labour force.

The new position is shown in diagram II. (This is the same as diagram I apart from the addition of the lines GN, DN, NK.) CL is 1 per cent of AC.

Diagram II



The 1 per cent addition to the labour force has shifted the line relating the marginal product of capital to the capital stock from GK to GN. Compared with the intial position, total output is up 1 per cent, from GDCA to GNLA; the wage bill is up 1 per cent, from GDF to GNF; total profits are up 1 per cent, from FDCA to FNLA.[1] Australian profits are FEBA, the same as they were initially. Foreign profits are ENLB, higher than they were initially in proportion to the rise in foreign capital.

[1] If labour could produce some output with no capital (see p. 191, n. 1), this output would be increased by 1 per cent. as a result of the increase in labour. The wage bill and total output would still be up by 1 per cent.

It will be noticed that the new marginal product of capital curve goes through G, as the old one did. This is obviously necessary for geometric reasons, if straight lines are used as in the diagram, to make the area under the curve increase by 1 per cent; and it can be shown mathematically that it is generally true, given our assumption of constant returns to scale. (With some production functions, the marginal product curve will be asymptotic to the vertical axis.)

If we allow for taxation the outcome will depend on fiscal policy. Since we are merely giving an illustration let us make the simple, though admittedly unrealistic, assumption that only profits are taxed and that the resulting revenue is used wholly to finance social services for workers. Since tax revenue from profits (Australian and foreign) will be 1 per cent higher than it was initially, social services per worker will then be maintained at the initial level, as will profits after tax per Australian capitalist.

If the criterion for immigration were that it should vary with foreign investment in such a way that variations in the latter should not affect the standard of living of workers or the average income of Australian capitalists, it would then be possible, given our present assumptions, to increase the labour force (compared with what it would otherwise have been) in the same proportion as the higher foreign investment increased total capital, i.e. by 1 per cent in our example.

This would, however, reduce average income per head. Population would be up by 1 per cent (we assume that Australian capitalists are also workers and that the labour force is a constant fraction of the population). But total income accruing to Australia would be up by less than 1 per cent since total labour income would be up by 1 per cent while total Australian profits were constant. This would be true whether we assumed (a) no taxation or (b) taxation of profits to finance social services with the latter counted as part of labour income and profits reckoned after tax. More generally, Australian income per head would be down whatever the nature of fiscal policy (provided that, as we are at present assuming, the tax rate on foreign profits is unchanged) because output would be up by 1 per cent and foreign profits after tax by more than 1 per cent so that Australian income would rise by less than 1 per cent, i.e. by less than population was increased.

If the criterion for immigration were that variations in foreign investment should not affect total income per head (and it may be worth repeating that this would not preclude a rising income per head over time), it would not then be possible to increase population by as much as 1 per cent. But some smaller increase would be possible since, if there were none, income per head would be raised by the extra foreign capital.

Numerous other immigration policies are conceivable that would allow population to vary with investment from abroad. The policy actually chosen will depend on the relative importance attached to growth of population and of income per head; views on the distribution of income; fiscal policy; the supply of would-be immigrants; and so on. The question remains, however, whether more immigration resulting from more foreign capital would bring a gain of income to Australia *additional* to the gains already described in sections II and III.

While this is highly likely it is not absolutely certain. For, though the extra labour would raise output in Australia, it would also raise the marginal product of capital and so foreign profits after tax, and possibly by as much as, or more than, it raised output; there would then be no further increase in total Australian income (including the income of the extra immigrants) or even a reduction of earlier gains.

To illustrate the possibility, consider the case depicted in diagram II. Compared with the position after the increase in foreign capital but before the increase in labour (with output GKLA), the increase in labour raises output by GNK but it also increases foreign profits, after tax, by (1–t)ENKI, and this could conceivably be as great as, or greater than, GNK.[1]

That an increase in Australian income is in fact very probable can conveniently be shown with the aid of a further diagram. The line SV in diagram III shows the marginal product of *labour* corresponding to different amounts of labour, with the total capital stock fixed at the level reached *after* the increase in foreign capital. OP is the labour force initially. If it is now increased a little (by immigration) to OU, output goes up by WVUP (ignoring the small triangle QVW). The wage bill goes up from RQPO to TVUO, i.e. by WVUP minus RQWT. Total profits go up by RQWT, Australian profits by (1—c)RQWT—shown as RXYT—and foreigners' profits by c(RQWT)—shown as XQWY—where c is the ratio of foreign to total capital. Foreigners' profits after tax go up by c(1—t)(RQWT), i.e. by (1—t)XQWY. Total Australian income thus changes by WVUP minus (1—t)XQWY, i.e. by WVUP minus c(1—t)RQWT, so that it will increase if $\frac{\text{WVUP}}{\text{RQWT}} > c(1-t)$.

Now $\frac{\text{WVUP}}{\text{RQWT}}$ is the 'elasticity of demand for labour' (as we shall call the elasticity of the amount of labour with respect to its marginal product, which equals the wage rate, i.e. of the line SV at Q).[2] If we call this elasticity e, the condition becomes $e > c(1-t)$. Now e is likely to be considerable, because the substitutability of labour for capital is probably fairly high, and almost certainly greater than c(1—t), which is of the order of $\frac{1}{10} \times \frac{1}{2} = \frac{1}{20}$. (An elasticity as low as $\frac{1}{20}$ would mean that, to employ 1 per cent more workers —say 40,000—with a given capital stock, but allowing all the time necessary for long-run readjustments, the real wage rate would have to fall by nearly one-fifth).

An increase in labour with capital constant is thus most likely to increase total Australian income. If extra immigration is allowed as a result of extra foreign investment it is thus most likely, on balance, to raise total Australian income beyond the level resulting from the gains described in sections II and III.

(It will be noticed that we have not relied in this section—as is sometimes done—on fixed technical coefficients, i.e. a fixed ratio of capital to labour, to show that more foreign capital will allow a larger labour force to be employed.

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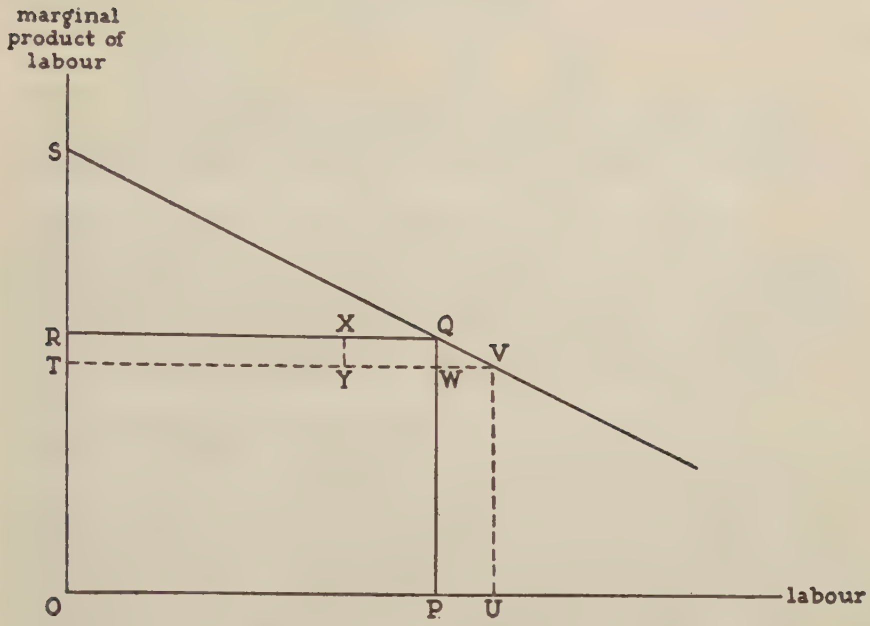
[1] If labour could produce some output with no capital, the increase in output would be greater than GNK, but it might still be less than (1—t) ENKI. (See also p. 194, n. 1).

[2] If L is the quantity of labour and M its marginal product,

$$\frac{\text{WVUP}}{\text{RQWT}} = -\frac{M\Delta L}{L\Delta M} \text{ approximately.}$$

Diagram III



The assumption of flexibility seems more realistic, especially as we are concerned with the long run and with the economy as a whole. The possible applicability of the analysis to ‘ dual ’ economies in underdeveloped countries will be briefly touched on in section XII.)

V

Now remove assumption (4) that the stock of Australian-owned capital is independent of the amount of foreign capital. The higher the stock of foreign capital at some future date the higher must the inflow be between now and then and the higher is the stock likely to be at most intervening dates. The higher therefore is Australian income likely to be in most intervening years, for reasons given in previous sections, if Australian-owned capital is unaffected by the higher foreign investment.

This may suggest that Australian savings and investment are likely to be higher so that at the future date the stock of Australian-owned capital will in fact be higher. Such a conclusion, however, becomes considerably less certain when account is taken of such factors as the redistribution of income between capital and labour resulting from increased foreign investment and from any consequent increase in immigration; and it is hard to know how government fiscal, monetary and other policies will react to the changing circumstances—such reactions will be important. It is not inconceivable that Australian-owned capital will be lower at the future date than it would have been in the absence of the extra foreign capital. To take an extreme, and no doubt exaggerated, example, extra investment from abroad might consist of purchases of existing Australian-owned assets, and the proceeds might be spent on extra foreign consumption goods, of a type not obtainable at home, whose importation was previously prohibited but is now allowed following the improvement in the balance of payments; the extra foreign-owned capital would then be fully offset by a reduction in Australian-owned capital.

The actual outcome is hard to predict. If, as is perhaps most likely, Australian-owned capital is increased, it can easily be seen, using the same type of diagrammatic analysis as before, that there will be a further increase in Australian income, over and above the increases described earlier, equal to the profits on the extra Australian capital plus the reduction in foreign profits, after tax, resulting from the lower profit rate. (The reduction in profits on the 'old' Australian capital will be a gain to Australian labour.) If this higher income leads to more immigration there will be a still further increase in total Australian income for reasons given earlier.

If Australian capital is reduced, Australian income will be less than it would have been (i.e. the gain for other reasons will be diminished) by the profits on the Australian capital not created plus the increase in foreign profits, after tax, resulting from the higher profit rate; and if immigration is in consequence reduced there will be a further reduction in total Australian income.

If Australia is prodigal enough to allow the extra foreign capital to be fully offset by a reduction in Australian-owned capital (compared with what it would otherwise have been), then Australian income at the future date will, on our present assumptions, actually be lower than it would have been had the extra foreign capital not come in. For, assuming no change in immigration policy, total labour, total capital and total output will be the same as they would have been, but of this output foreigners will get an extra amount equal to the profits, after tax, on their extra capital; if, in the circumstances, immigration were reduced, there would be a further reduction in Australian income.

VI

Now remove assumption (5) and allow for possible external economies from extra foreign investment in Australia, i.e. economies external to the foreign firms investing the extra capital. If the value added to output by this capital exceeds the profits, before tax, earned on it the difference will be the value of such external economies. These will very probably bring a further gain to Australia.

We shall still assume that there are no external economies *of scale* resulting from the growth of the Australian economy generally; such economies will be considered in the next section. We shall be concerned at present only with external economies of foreign investment resulting from other factors such as (i) the breaking of bottlenecks (probably much less important now than it may have been in the early post-war years) and (ii) the introduction of ' know-how ' by foreign firms.

Such know-how is presumably becoming less important as Australian technical and administrative knowledge broadens. It is perhaps hardly worth mentioning that it can bring an additional gain to Australia only if it gets outside the foreign firms. This may happen where, for example, the latter train workers who are later employed by Australian firms or where the superior techniques they bring to the country are somehow passed on to locally-owned businesses which are both made aware of them and forced to adopt them if they are to survive foreign competition. If any gain accrues to Australia from this ' know-how ', it does not necessarily mean that it might not have been preferable to buy or hire it without importing the capital.

While these external economies seem likely to bring an extra gain to Australia, they might conceivably reduce the gains mentioned earlier. The extra gain (which may be negative) will be equal to (a) the resulting change in the wage bill plus (b) the resulting change in profits of Australian capitalists plus (c) the tax on the resulting change in profits on the ' old ' foreign capital. If the benefit of the external economies spreads to both capital and labour—and this seems *a priori* the most likely outcome—(a), (b) and (c) will all be positive and there must be a further gain to Australia. There must also be a further gain so long as labour benefits, even if capital loses; for, since the external economies will presumably increase output, labour's gain must exceed capital's loss, and only part of the latter is borne by Australia. There will still be a further gain even if labour does not benefit at all, provided there is no absolute reduction in the wage bill. But if there is an absolute reduction, Australia *may* lose.

Such a reduction might occur if, for example, the presence of extra foreign firms spread knowledge of production methods that enabled other firms to produce the same output with their existing capital but with less labour while the marginal product of labour at full employment was reduced. There would then, as a result of the external economies, be a higher total output in Australia but a lower wage bill. Profits would go up more than the wage bill fell. This would, however, presuppose an improvement in techniques rather heavily biased towards labour-saving as opposed to capital-saving.

The possibility is illustrated in diagram IV[1] (p. 200). The external economies shift the marginal product of labour curve from the full to the dotted line. Output is up by E—C—B, which is positive. The wage bill is down by A+B. Profits are up by E+A—C.

Australia would, however, lose only if labour's loss was nearly as large as capital's gain. For she would get the great bulk of the latter, either in profits

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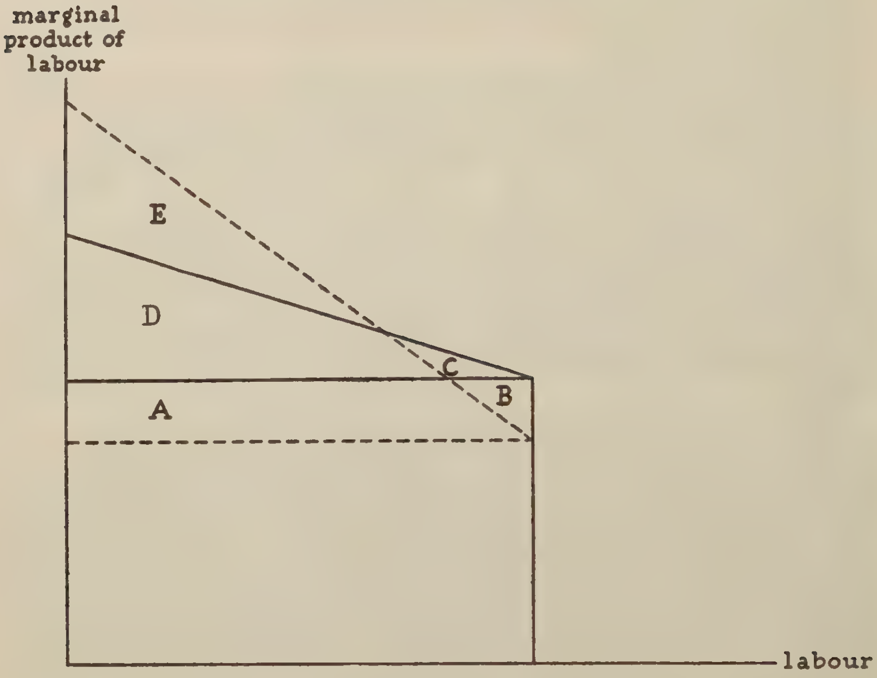
[1] It is assumed that capital could produce no output if there were no labour. This is analogous to the assumption mentioned on p. 191, n.l.

Diagram IV



or in taxes, actually $1-c(1-t)$ of capital's gain where, as before, c is the ratio of foreign to total capital and t the rate of tax on profits. Taking c and t as of the order of $\frac{1}{10}$ and $\frac{1}{2}$, Australia would gain about $\frac{19}{20}$ of the increase in profits. She would thus lose only if labour's loss were more than about $\frac{19}{20}$ of capital's gain, i.e. only if the redistributive effect of the external economies were large compared with the gain in output.

Australia's loss could not, at worst, be more than about $\frac{1}{20}$ of labour's loss. While it cannot be proved that this would necessarily be small relative to the gains from foreign investment described above, it seems likely that it would be. It is hard to believe that an increase in foreign capital equal to, say, 1 per cent of total capital could change production methods sufficiently to redistribute more than say 1 per cent of the national income from labour to capital. But this would reduce Australian income by not more than about $\frac{1}{20}$ per cent, whereas it can be seen, by taking plausible figures, that the extra foreign capital might well increase Australian income by, say, $\frac{1}{2}$ per cent or more for reasons given in previous sections.[1]

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[1] Of course, if the external economies benefited foreign more than Australian capitalists in relation to their respective capitals, Australia's loss could be greater; but this would be inconsistent with our present assumption of perfect competition which means that the profit rate is the same for Australian and foreign capital.

In conclusion it seems likely that external economies (other than economies of scale) resulting from extra foreign capital will further increase Australian income. There is no obvious *a priori* reason why the economies should be biased towards labour-saving rather than capital-saving; even if they were, they would reduce Australia's income only if they caused an absolute loss to labour, and a loss, moreover, that was nearly as large as capital's gain. Any loss to Australia would, in any case, probably not be large relative to the other gains from foreign investment.

Any gain from external economies would bring a further gain from extra immigration (given any likely criterion for immigration policy), and possibly from extra Australian capital; the reverse would be true of any loss from external economies.

VII

Now remove assumption (6) and allow for the possibility of economies of scale in the sense that, if labour and capital were both increased by 1 per cent, output would increase by more than 1 per cent, whether the extra capital were foreign or Australian. The economies of scale considered here do not, therefore, include any external economies resulting from the presence of more foreign, as distinct from Australian, capital; these latter economies could arise even if there were no increase in total capital or in labour, the extra foreign capital being offset by a reduction in Australian capital.

Economies of scale could be external to firms or internal; the latter type would be possible only under imperfect competition, about which more will be said in the next section. The economies could be biased in a labour-saving or in a capital-saving direction as in the case of the external economies described in the last section. They seem likely, however, to bring a further gain to Australia when foreign capital is increased. There could conceivably be a loss for reasons similar to those discussed in the last section, but this seems intuitively to be even more improbable, since a mere increase in scale seems less likely to cause drastic changes in methods of production than the presence of additional foreign capital, where the quantity of extra capital is the same in both cases.

Gains from economies of scale will, of course, allow further gains from extra immigration (and possibly from extra Australian capital), and conversely for losses.

VIII

So far we have assumed perfect competition. It might be argued that this was a reasonable assumption on the ground that, according to some post-war studies, it corresponds fairly closely to reality in the long run, or at least more closely than many pre-war theories implied. If, on the other hand, we remove assumption (7), and allow for imperfect competition, the analysis becomes much more complex and it is not easy to make useful generalizations about the modifications required in our previous analysis.

Assume first that the same ' normal ' rate of profits is earned everywhere. Wages plus ' normal ' profits will then exhaust the total output but the reward per unit of capital or labour will be the marginal *revenue* product, which is the marginal *physical* product (assuming the firm expands) *less* this product multiplied by the reciprocal of the elasticity of demand facing the firm (where this elasticity is defined so as to be positive).[1] The *ratio* of the wage rate to the profit rate will still, however, equal the ratio of the marginal *physical* products of labour and capital.

If, now, growth took place wholly through multiplication of identical firms, and assuming no external economies, a given proportionate increase in both capital and labour would result in the same proportionate increase in the number of firms and in total output. There would thus be constant returns to scale for the economy as a whole. (The latent internal economies of scale implicit in our assumptions—according to a well-known theorem in the theory of the firm—would not be exploited). It is intuitively plausible that each factor would then receive its marginal (national) *physical* product, even though it received less than what the marginal physical product would have been had individual firms expanded; a proof is given in the footnote.[2] On

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[1] We assume a perfectly elastic supply of labour and of capital to the firm. Units of each product are defined so as to make their prices unity. The demand curve for each firm will be tangential to its average cost curve.

[2] Let the production function of each of n firms be $y=f(k, l)$, where y is output, k capital and l labor. Let Y, K, L be corresponding totals for the economy, π the profit rate and w the wage rate. Suppose an increase in total capital sufficient to allow for an extra firm producing the same output as each old one and for the maintenance of the output of each old one. Part of the extra capital will go into the new firm and part into the old firms to compensate for the labour withdrawn for use in the new one.

The increase in total output is the output of the new firm which equals that of each old one,

i.e. $$\Delta Y=y \tag{1}$$

Rewards to the factors exhaust output in each firm,

i.e. $$y=k\pi+lw \tag{2}$$

The increase in total capital is the capital in the new firm plus the increase in capital in all the old ones,

i.e. $$\Delta K=(k+\Delta k)+n\Delta k \tag{3}$$

There is no change in the output of the old firms,

i.e. $$\Delta k\frac{\partial y}{\partial k}+\Delta l\frac{\partial y}{\partial l}=0 \tag{4}$$

The ratio of the profit rate to the wage rate equals the ratio of the marginal physical products of capital and labour (assuming firms were to expand),

i.e. $$\frac{\partial y/\partial k}{\partial y/\partial l}=\frac{\pi}{w} \tag{5}$$

From (4) and (5), $$\pi\Delta k+w\Delta l=0 \tag{6}$$

From (1), (2) and (3), $$\frac{\Delta Y}{\Delta K}=\frac{k\pi+lw}{k+(n+1)\Delta k}$$

substituting from (6) $$\frac{\Delta Y}{\Delta K}=\pi\left[\frac{k\pi+lw}{k\pi-(n+1)w\Delta l}\right]$$

Now $-n\Delta l$ is the labour in the new firm (being the sum of the transfers from the old firms) and therefore also the labour in each old firm in the new situation. In the old situation their labour (l) was $-\Delta l$ greater. Therefore $-(n+1)\Delta l=l$.

Hence $\frac{\Delta Y}{\Delta K}=\pi$, i.e. the profit rate equals the marginal national physical product of capital. Similarly for labour.

these assumptions, therefore, the preceding analysis applies. It would also seem to be a reasonable approximation even though firms are not identical, provided the new ones were representative.

If, at the other extreme, growth took place wholly within existing firms, each growing in the same proportion, the latent internal economies of scale would be exploited and capital and labour would get less than their marginal physical products. Extra foreign capital would then probably bring a gain to Australia as a result of the internal economies; for the profits it earned would be less than the extra output it created, the difference going to existing factors. This gain, however, is merely that resulting from economies of scale and already allowed for in the previous section.

On the above assumptions, therefore, imperfect competition does not seem to require much, if any, modification of our previous analysis. The assumptions are, of course, unrealistic. For example, in so far as the foreign capital creates new firms, these may, to get a foothold in the market, have to charge prices lower than those ruling for similar existing products that are in no way superior, simply because buyers are conservative in their habits. The new firms, if they used the same techniques, would then make a lower rate of profit than that earned elsewhere—there would no longer be the same ' normal ' rate everywhere—and there would be a gain to Australia additional to those already considered. The same might be true in so far as growth was within existing firms, for extra foreign capital would probably be concentrated on a small proportion of such firms, especially those in which foreign capital was already invested.

On the other hand, the growth of foreign firms might put them in a monopolistic position in which they could exploit Australian buyers, and this might involve a loss to Australia. (Foreign investment need not, of course, foster monopoly. On the contrary, it may break down local monopolies and, by accelerating the growth of the economy and so of the Australian market, widen the scope for competition by increasing the number of firms of reasonable size possible within existing industries.)

Endless further examples could be elaborated, but this would be pointless. The present method of analysis is admittedly unsatisfactory for dealing with imperfect competition and a better method might substantially modify our earlier results. On the other hand, we have seen that, on certain assumptions, the perfect competition analysis gives a reasonable first approximation, and that the removal of these assumptions leads to modifications that do not all work in the same direction and may partly cancel each other out.

IX

Now remove assumption (8) and allow for possible effects of investment from abroad on the terms of trade. We still assume in this section that the balance of payments can be adjusted smoothly as required, so that international reserves are held constant without economic or social cost by, among other things, variations in exchange rates or in Australia's cost level relative to cost levels abroad with fixed exchange rates.

Let us start by also assuming, as is quite common in the analysis of such problems, (i) that trade barriers are not raised and lowered to correct tendencies to international deficit and surplus respectively; (ii) that an improvement in the balance of payments requires a worsening in the terms of trade, and conversely. On these assumptions, which will be critically reviewed later, extra foreign investment may affect the terms of trade in three main ways.

First, the transfer of the profits abroad will tend to require a worsening in the terms of trade to generate the necessary surplus in the other items of the balance of payments.

Secondly, the terms of trade may be affected by the increase in output and income in Australia resulting from the extra foreign investment, and by any consequent changes abroad (output abroad might, for example, be less than it would otherwise have been because there is now less capital for investment there). The outcome will depend on such factors as the pattern of changes, at home and abroad, in supply of, and demand for, different types of goods (especially export-type, import-type and other). This raises very large questions that cannot be discussed here, but it seems that the terms of trade might tend to be either worsened or improved.

Thirdly, the movements of capital across the exchanges will affect the terms of trade. An inflow will tend to improve them, by creating a tendency to surplus in the balance of payments (which, on our present assumptions, has to be corrected), provided the capital does not reflect entirely additional imports of capital goods and remembering that the government is assumed to maintain a constant degree of employment (otherwise we should have to allow for the inflationary effects of complementary Australian investment and the like). Similarly, the terms of trade will tend to worsen if and when the foreign capital flows out again. (This may happen even with direct investment if, for example, depreciation allowances are repatriated or if foreign assets are sold to Australians.)

It is hard to say whether, on balance, these various forces will improve or worsen the terms of trade. Fortunately, however, this does not matter too much, since any change is unlikely to be very large—once more for three main reasons.

First, it is rather widely believed that the terms of trade are to all intents and purposes a *datum* for Australia. The supply of imports must certainly be highly elastic since imports are such a small fraction of consumption of similar goods abroad; and, while one cannot be so confident about the elasticity of demand for exports, this too seems likely to be high, in the long run we are here considering, especially when account is taken of competition between wool and synthetic fibres.

Secondly, even if the terms of trade are not a *datum*, deficits or surpluses may in practice be prevented, in part at least, by a raising or lowering of trade barriers which limits any worsening or improvement in the terms of trade.

Thirdly, even if trade barriers are not varied in this way, tendencies to imbalance may be largely corrected by other measures so that only small changes in the terms of trade are required. Dr. I. F. Pearce, in an interesting paper not yet published,[1] has argued that, assuming 'full employment' is maintained at home and abroad, a country's balance of payments deficit, for example, can usually be removed in large part by (i) a cut in expenditure at home approximately equal to the deficit, together with a corresponding increase in other countries (which will be necessary to maintain full employment there as their surplus vanishes); (ii) a reduction, by exchange depreciation or otherwise, in the prices of non-traded goods at home relative to the prices of *both imports and exports*, and conversely abroad. These, in his view, are the important changes in relative prices necessary to restore balance. They will help to do so by stimulating production, and discouraging consumption, of both import-type and export-type goods at home, and conversely abroad. Any change in the ratio of import to export prices is, by contrast, likely to be relatively small. (He also reaches the somewhat surprising conclusion that any change in the terms of trade is equally likely to be in either direction; but whether this is a valid generalisation, and whether it applies to Australia, are questions that cannot be pursued here.)

For all these reasons any gain or loss through changes in the terms of trade resulting from extra investment from abroad seems unlikely to be large. If there is a loss it is most unlikely to offset the gains already mentioned (this could, I think, be shown by an analysis broadly similar to one developed in another context[2]); nor does it seem likely to be as important as the losses that could arise for reasons given in the next section.

X

We now remove assumption (9) and allow for the balance of payments problems that may arise if Australia runs into substantial deficit. If exchange rates are fixed, reserves inadequate, and emergency overseas borrowing impracticable or undesirable, there will probably have to be (a) deflationary measures that will interrupt growth and cause unemployment of resources —we are here removing assumption (1)—except in so far as the deficit can be removed by eliminating excess demand; and possibly (b) intensified import restrictions that may cause shortages, disrupt production and investment plans, create rigidities in the economy and involve more than optimum protection (this may also happen if tariffs are raised). If the currency is devalued there will be social problems and a weakening of trust in the Australian pound. Moreover, devaluation may not quickly remove the deficit because, though trade may be quite highly responsive to relative price changes in the long run, it is much less so in the short run; deflationary measures and restrictions may thus have to be maintained for some time.

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[1] 'The Problem of the Balance of Payments.'

[2] MacDougall, *The World Dollar Problem*, Appendix XIIF.

Nor would freely fluctuating exchange rates solve the problem; and they have various disadvantages of their own.[1]

The question is whether extra investment from abroad might contribute to these troubles. The analysis required is quite different from that of possible effects on the terms of trade.

Let us assume for the moment that there are no large and rapid fluctuations in the flow of new investment. If then, with a given flow, the Australian balance of payments tends to improve over the years ahead with fixed exchange rates, an increase in foreign investment will not cause trouble by swelling the profits that have to be remitted across the exchanges, provided the increase is not too large. If, on the other hand, the balance tends to worsen with a given flow of investment, recurring crises will in any case be likely. Extra foreign investment would not necessarily then aggravate them; it might alleviate them. The higher payments of profits abroad might be offset, or more than offset, by the higher capital inflow and by favourable effects on the balance of payments resulting from the extra production; for this might be what is sometimes called 'import-saving' or 'export-creating'.[2] Extra foreign investment might, however, aggravate the problem, especially if it were 'import-creating' or 'export-discouraging'. There could then be more serious and more frequent crises and the resulting losses would have to be debited against the gains from extra foreign investment described earlier.

One convenient method of assessing the future trend of the balance of payments, given fixed exchange rates, is to consider first the likely course of the Australian price level relative to price levels abroad (i.e. the comparative rates of inflation, if any), and secondly any 'structural' changes that might affect the balance of payments even if price levels at home and abroad moved in line. It is possible to be pessimistic or optimistic on both counts. No judgment is attempted here but, if one were only moderately optimistic, it would not seem that a continuation of something like the post-war rate of growth of private foreign investment in Australia during, say, the decade ahead would obviously cause trouble.

An uncritical interpretation of the crude figures may exaggerate the past rate of growth. They suggest that between mid-1947 and mid-1958 the value of direct foreign investments outstanding rose by an average of 15 per cent a year.[3] A more careful examination substantially alters the picture. First, the crude figures include undistributed profits of subsidiaries only since 1947; if those accumulated earlier were added, the rate of growth might be reduced to perhaps 13 per cent a year. Secondly, and much more important, it seems that a large part of the increase merely reflects the fall in the value of money (both between 1947 and 1958 and before 1947; for the fixed assets existing at mid-1947 were all installed before that date). A very rough (but complicated) calculation, based on a method used in another context,[1] suggests that the rate of increase of direct investments, in real terms, may have been only about 6 per cent per annum. While not much significance can be attached to this result, a check on its plausibility is that, in money terms, income on foreign investments in Australia (excluding public authority interest) rose from about 1.1 per cent to about 1.3 per cent of the gross national product during the same period.[2] This is not inconsistent with investments outstanding rising by 6 per cent a year in real terms and the real national product by, say, 4-5 per cent.

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[1] For a fuller discussion by the present author see, e.g., *op. cit.*, pp. 335–42, 383–7, and 'Flexible Exchange Rates', *Westminster Bank Review*, August 1954.

[2] The correct meaning of these much-abused terms varies with the context. Here we are really combining them and postulating that, apart from the capital inflow and the additional profits payable abroad, the extra investment is 'balance-of-payments-improving', given fixed exchange rates. To determine whether this was likely, we should have to assess (*a*) any effects on Australia's price level relative to price levels abroad and (*b*) any 'structural' effects on her trade (see next paragraph); these would comprise the effects of faster growth generally (whether financed by foreign or Australian capital) and of any special twist given by the foreign capital to the pattern of development. As is well-known, such an assessment is difficult, not least because the indirect effects can be so important.

[3] Including undistributed profits of subsidiaries since mid-1947. Calculated from tables 5, 6, 8, 9 of *Annual Bulletin of Oversea Investment*, 1957–58.

If, in future, foreign investments grew at 6 per cent per annum in real terms (one can admittedly make more startling extrapolations by taking U.S. and U.K. investments separately),[3] the growth of income on them would not obviously be embarrassingly rapid in relation to the growth of trade; for, with the real national product growing by, say, 5 per cent a year, trade may well tend to grow by, say, 4 per cent in real terms (there may be reasons why it will grow more slowly than the national product but the difference is unlikely to be very great). Since profits on foreign investments in Australia are still quite a small fraction of trade in goods and services, imports would not have to rise so very much more slowly than exports to cover the growing income payable abroad, even if we ignore the growing support to the balance of payments that would result from the rising inflow of new capital.[4]

If we now remove the assumption of no large fluctuations in this inflow, there is the possibility that these might help to cause crises, especially if a sharp reduction in the net inflow (allowing for withdrawals of foreign capital) coincided with a worsening in the balance of payments for other reasons. The higher the average flow over a period of years the more serious is this danger likely to be and this is a further cost of more rather than less investment from abroad. (The extra danger would, however, be diminished or removed if more investment resulted in an improved balance of payments, and a building up of reserves, either automatically or through deliberate policy.)

It is not obvious that the inflow of private capital will become a dangerously high fraction of the balance of payments in the foreseeable future. It has averaged only about 10 per cent of payments on current account in recent years (including undistributed profits),[1] and we have seen that it will not grow so very much faster than trade if the post-war trend continues. Nevertheless, the net inflow can contract sharply—it fell by over two-thirds between 1951–2 and 1952–3 and might even become negative—and a loss of even, say, 7–10 per cent in foreign exchange receipts can be embarrassing when reserves are low, especially if other receipts are falling at the same time.

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[1] MacDougall, *op. cit.*, pp. 534–5. There is no space to describe the calculations for Australia, and little need since the result is purely illustrative.

[2] Calculated from papers on *National Income and Expenditure*; adjusted for annual fluctuations. The figures are not quite comparable with those given earlier.

[3] See Arndt, *op. cit.*, p. 258.

[4] The relationships between growth of trade, foreign investment, and income on it could be further elaborated, but this seems unnecessary for our present purpose.

Direct investment may be less dangerous in this respect than portfolio investment in Australian companies, since the latter is probably more volatile. (It also brings little, if any, know-how, one of the main gains from direct investment; and, though the rate of return on it may appear lower, this becomes less certain if allowance is made, as with direct investments, for the undistributed profits being set aside for the benefit of shareholders.)

XI

Finally let us remove assumption (10), that the increase in foreign capital considered does not require changes in Australian policy that themselves may involve a loss. The previous analysis would require no consequent modification if we were considering the effects of changing conditions abroad, say a fall in the rate of profit there that encouraged the flow of capital to Australia. But if, say, the govenment were considering whether to provide more information abroad about investment opportunities in Australia, the cost of so doing would have to be debited before striking a balance. Attempts to attract foreign capital by firmer guarantees on freedom to repatriate might increase the danger of future balance of payments difficulties. Higher protection, designed to encourage investment in Australia by foreign producers thereby prevented from exporting direct, might mean sacrificing some of the benefits of the international division of labour; there might also, of course, be further well-known benefits from higher protection, but some of these have already been allowed for in this paper.

Conversely, measures that might reduce capital inflow, such as insistence on a minimum Australian participation in the equity of subsidiaries of foreign firms or the outlawing of restrictions on exporting by such subsidiaries,[2] might bring other economic or political benefits.

The only case we shall consider in any detail is where investment from abroad is encouraged by a reduction in tax rates on foreign profits, whether or not this applies equally to domestic profits. (The analysis will, of course, apply in reverse to higher tax rates.) If rates are reduced, the gain from taxation will be smaller than that described in Section III. There could even be a reduction in tax revenue from foreign profits.

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[1] The balancing item is excluded; see R. J. Cameron, *Economic Record*, August 1957, pp. 263–4.

[2] Cf. H. W. Arndt and D. R. Sherk, 'Export Franchises of Australian Companies with Overseas Affiliations,' *Economic Record*, August 1959.

It can easily be shown that this will be avoided if

$$\frac{\frac{1}{\eta_d}+\frac{1}{\eta_s}}{1+\frac{1}{\eta_s}} < t$$

where t is the tax rate as before and η_d and η_s the elasticities of demand[1] for, and supply of, foreign capital; they measure the relationship between changes in the *stock* of foreign capital in Australia and in the profit rate, before tax in the case of demand, after tax in that of supply. If we took the tax rate as one-half, this would reduce to

$$\eta_s > \frac{1}{1-\frac{2}{\eta_d}}$$

If, for example, η_d were infinite, 10, 4 or 2, η_s would have to be not less than 1, 1¼, 2 or ∞. We have seen that η_d is probably high, so that a fall in tax revenue might be avoided if the elasticity of supply of foreign capital were not less than, say, some figure between 1 and 2.

It might be thought that this was highly probable since foreign capital in Australia is such a tiny fraction of foreign capital abroad. But the market is very imperfect; only a very small fraction of all foreign capitalists are interested in investment in Australia. An elasticity of supply of, for example, 1½ would mean that, if the rate of profit, after tax, on foreign capital were, say, 9 per cent rather than 8 per cent, this would in the long run make a difference of nearly one-fifth, or perhaps £250 million or more, in the amount of foreign capital in Australia. Whether this is likely it is very hard to say.

It certainly seems possible that, if investment from abroad were encouraged by tax remission, there would be no gain to Australia from increased tax revenue, at least if we confine our attention to the stage of the analysis reached in section III. The reduction in tax rates might still be worth while, for the other consequences might be favourable to Australian income on balance (and might possibly convert a tax loss into a tax gain). But it should be remembered that any gains from higher immigration, and possibly more Australian capital, would now be substantially smaller than in our previous analysis, because they there depended considerably on the rise in Australian income resulting from higher tax revenue from foreign profits.

XII

The main conclusions of this analysis are fairly straightforward and obvious. The most important direct gains to Australia from more rather than less private investment from abroad seem likely to come through higher tax revenue from foreign profits (at least if the higher investment is not induced by lower tax rates), through economies of scale and through external economies generally, especially where Australian-owned firms acquire ' know-how ' or are forced by foreign competition to adopt more efficient methods.

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[1] Defined so as to be positive.

These gains may permit higher immigration, which will further increase Australian income, if immigration policies are related in some way to the standard of living. They may also lead to higher domestically-financed investment, which will later increase Australian income still further, but this is problematical and depends considerably on government policy; if domestically-financed investment were allowed to fall when more foreign capital came in, Australian income could actually be lower at some future date than it otherwise would have been.

The effects of extra foreign investment on the terms of trade, which might be favourable or unfavourable, are unlikely to be large. The effects on the balance of payments could be more important. They could be favourable, but the danger of future balance of payments crises might be increased; for there are inevitably fluctuations in the net inflow of private capital and part at least of the foreigners' profits have to be transferred across the exchanges.

These are some of the results obtained by applying rather conventional tools of economic analysis. The assumptions used are still highly simplified even after those listed at the beginning of the article have been removed. For example, allowance is made for only two factors of production. No distinction is made between fixed interest and equity investment. No explicit account is taken of government-owned capital or of government borrowing from abroad; throughout most of the paper these are implicitly assumed to be independent of changes in private investment from abroad. The analysis, as was emphasised at the outset, is mainly static. Even if it were made more dynamic it would still fail to take account of considerations not allowed for in most economic theories and about which the economic historian, for example, might have more useful things to say. Many aspects of the problem are left uncovered, such as the relative merits of government borrowing and private investment from abroad, and little is said about short-run implications. No attempt is made to assess the political costs and benefits.

The analysis will not apply to countries other than Australia without modification, but such modification may sometimes be possible. In many underdeveloped countries, for example, there may be heavy unemployment of labour, or under-employment where the marginal product is far less than the wage rate, and marginal product, of labour in the organised sector, or perhaps even zero. The foregoing analysis might then perhaps be adapted by considering the organised sector and assuming employment in it to be as great as was feasible at a given real wage rate; more investment from abroad would then make possible more ' immigration ' from the unorganised sector just as, in section IV, we allowed for the possibility that it might permit more immigration into Australia from overseas.

Despite its many limitations it is hoped that the analysis in this paper may be of some relevance, at least to Australia, and that it may provoke others to correct and improve it and to explore other aspects of the problem.

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DOMESTIC VERSUS FOREIGN INVESTMENT[1]

By T. BALOGH *and* P. P. STREETEN

I

Introduction

The problem of the relative merits of home and foreign investment from the point of view of a capital exporting country has once more been raised in a *Symposium* published in the BULLETIN OF THE INSTITUTE OF STATISTICS on the future of the Sterling Area, and by some comments made in *The Observer* by its Economic Editor.[2] Some of the arguments apply, *mutatis mutandis*, to capital importing countries.

We are, generally, in agreement with Sir Donald MacDougall's paper. He has, however, confined himself to a rigorous analysis based on rather restrictive assumptions, and he is mainly concerned with a country receiving capital from abroad. A discussion of some of the wider issues, also from the viewpoint of a capital exporting country, may therefore be in order.

Some of the differences of opinion arise from the fact that different authors discuss the problem on different levels of abstraction and on different assumptions. This is evident in Mr. Scott's recent analysis[2] of Mr. Shonfield's advocacy of a general discouragement (in contrast to selective control) of capital exports, and stimulus to domestic investment and capital imports.

Mr. Scott initially assumes perfect competition and infinitesimal changes. When he relaxes the assumption of perfect competition, he replaces it by marginal revenue equals marginal cost and full cost pricing. When he relaxes the assumption of infinitesimal changes he confines himself to indicating the diminishing marginal productivity of capital.

Mr. Shonfield overstates the case for home investment, confuses value added with the marginal productivity of capital and marginal with average yield, and derives policy conclusions from irrelevant statistics. But the kernel of truth in the thesis is that the geographic product in the country where higher investment occurs will tend to increase by more than the amount appropriated by the investor.

Whether a country should, from a national point of view, discourage capital exports and encourage capital imports will depend on the relation between the divergence of private profits and national gains at home and abroad. We first discuss some of the causes that give rise to such divergences under the headings of (i) external economies in disequilibrium, (ii) terms of trade, (iii) indirect effects of foreign investment on employment and income in conditions of non-Keynesian unemployment, underemployment and differential labour productivities, and (iv) the effects of certain policies, including taxation.

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[1] We have much benefited from discussions with Sir Donald MacDougall, who, however, has obviously no responsibility for any remaining errors, and from comments by Mr. Scott.

[2] *Bulletin of the Oxford University Institute of Statistics*, November 1959. *The Observer*, February 28th, 1960. See also A. Shonfield, *British Economic Policy Since the War*, 1st edition, p. 109, 2nd edition, p. 110.

II

External Economies

We think that the essence of the case for curbing foreign and encouraging domestic investment can be stated quite simply. The later elaboration attempts to show the precise mechanism by which private profits will tend to diverge from national benefits.

It is obvious that this case can be based only on the assumption that the benefit from the act of investment is greater than the resultant increase in the income of the investor and that the locus of this benefit will be determined by the locus of the investment. Theoretically it must therefore be considered as an external economy.

Consider an act of investment which raises world product. If the whole increase resulting from this investment can be appropriated by the investor, social and private returns are equal. But normally he will have to share it with others, for the new investment will raise wages or lower prices, so that workers, other entrepreneurs and consumers generally will benefit. Some of these benefits will be offset by losses to other income groups. But in certain conditions, specified later, there is bound to be a *net* increase in production which does not accrue to the investor.[1]

Granted the existence of such net external gains, the question arises whether the chances are not higher that they will accrue to nationals if the investment is domestic, and to foreigners if it is undertaken abroad. Tax considerations would certainly suggest an affirmative answer, terms of trade and employment considerations may, however, modify it.

We are here concerned not only with those external economies where the *output* of one producer is affected directly by the *output* of other producers, but also with those discussed by the writers on underdeveloped countries (e.g. Nurkse), which arise from *finite* additions to plant and equipment and from the *disturbance of equilibrium.*[2] They relate the incomes and profits of one group of people to the actions of other people. We are concerned with the wider concept of *pecuniary*, not only with the narrower concept of *technological* external economies. It is, however, not only in underdeveloped countries that these can be important, but also in advanced industrial countries.

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[1] It is, of course, possible to envisage situations in which the investor is able to sweep up more than the increase in production; then private returns exceed social returns.

[2] The concept of ' external economies ' here used was first elaborated by Allyn Young (*E.J.* 1928): ' Every important advance in the organisation of industry, regardless of whether it is based upon anything which, in a narrow and technical sense could be called a new ' invention ', or involves a fresh application of the fruits of scientific progress to industry, alters the conditions of industrial activitity and initiates responses elsewhere in the industrial structure which in turn have a further unsettling effect ' (p. 533). Allyn Young focused attention on external cost reduction, Rosenstein-Rodan shifted the emphasis to external investment incentives which are due to demand-creation (*E.J.* 1943). In both cases profits of others have risen. Balogh applied Rodan's concept to foreign investment policy (*O.E.P.* 1945). Nurkse and Hirschman further elaborated the concepts in the setting of underdeveloped countries. Scitovsky's distinction greatly clarified the discussions and one of the two present authors, Paul Streeten, has much benefited from it and used it in his contribution to this article. (' Two Concepts of External Economies ', *J.P.E.*, April 1954.) Arndt, too, has helped in sorting out the different meanings. ' External Economies in Economic Growth ' (*Economic Record*, 1955).

Let us begin with a cost-reducing investment in a particular industry which leads to expansion of its capacity. The prices of its products will be lowered and the rewards of its factors will be raised. The lower product prices benefit the users of the product, the higher factor prices benefit the suppliers of the factors. It is, of course, true that the suppliers of rival products and the hirers of rival factors will suffer some losses. But the cost-reducing investment has raised the real national product as a whole, and in so far as this increase is not wholly appropriated by the investor there must be a *net* addition to some other incomes.

These benefits are partly Marshallian consumers' and producers' surpluses, partly the result of outward shifts of the production-possibility locus (upward shifts of the marginal productivity curve if index-number problems are solved), not wholly appropriated by those responsible for the shift. They depend on either (i) a finite addition to total production with equilibrium restored after the investment is carried out, or (ii) a disturbance of equilibrium that sets other profit-seeking actions in train, which move the system away from the original equilibrium.

III

Disequilibrium

When the analysis proceeds on the assumption of marginal productivity of capital schedules, the rate of return on capital is the *rate of interest* that would prevail if all long-term adjustments were made and full equilibrium had been reached. *Profits*, however, are a sign of *disequilibrium*, and an incentive to its removal. The investment may then eliminate the profits as it restores equilibrium. But investment may also raise profits in other industries and thus income and savings. It then leads away from the original equilibrium position. Investment in steel makes steel cheaper. This means bigger profits in building, which uses steel. This leads to expansion in building. This in turn raises steel profits and leads to further expansion in steel. Equilibrium is reached only when successive doses of investment in all industries affected have eliminated profits everywhere. Only then is the socially desirable amount of investment also the profitable amount. This position need never be reached in principle, and, as we emphasised above, is never reached in fact. Thus initial profitability in each single industry understates social desirability not only by the whole of producers' and consumers' surpluses, but by more—*viz.* by the benefits from the series of consequential adjustments towards a steadily receding and changing ' equilibrium ' position.[1]

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[1] The fact that investments are planned on the assumption that growth will continue and that demand will expand faster if price is lowered does not affect the argument. Since the expectations of the majority are bound to be less optimistic than those of the optimists, there must be external economies for the more cautious.

Investment in (say) steel may also give rise to profits in

(*a*) coal if coal is used in steel production;

(*b*) cement if steel and cement are complementary;

(*c*) oil if oil is a substitute for coal;

(*d*) consumption goods bought by the now better-off steel, coal, cement and oil workers.

Any losses in substitutes for steel products used in the production of these substitutes, complements with these substitutes, substitutes for the products used in the production of substitutes, and goods bought by factor-owners suffering these losses, must be on balance less than the gains, if the initial investment has shifted the production possibility locus outwards.

Investment that lowers the cost of producing a certain product is only one instance of investment moving the system away from equilibrium by giving rise to higher incomes and profits in other sectors. Besides cost-reducing investment there is product-improving and product-innovating investment, and these, too, will initiate a series of consequential investments.

A policy guided by the national interest ought to consider all the various types of external economy. It cannot be expected that investors in one industry (say steel) should take into account the consequential benefits, not because they lie in the future and are uncertain, but because success depends on the investment decisions of others, based, in turn, on their expectations of investment in steel. Discrimination against investment abroad by itself will not guarantee that the chain reaction of domestic investments will be set off. But if the conditions for such a cumulative expansion are present, either because there is an alert entrepreneurial class, or because the government is ready to take positive action to coordinate investment plans, the withdrawal of capital from abroad can be an important source of capital.

Three questions may be raised at this stage. First, why need the capital that sparks off the growth process be drawn from abroad rather than from another domestic investment project? Secondly, would not the growth process attract capital from abroad, or capital that would otherwise have gone abroad, even in the absence of government restriction? Thirdly, could it not be that the cumulative process would yield higher returns to the investing country if it took place abroad than if it were ' artificially ' fostered at home?

The answer to the first question is that the sources of capital for the expansion triggered off by the initial intervention are indeed many. They are (1) the growth of incomes due to economies of scale and innovation, (2) the higher savings ratios called forth both by (1) and by the newly-opened up investment opportunities, (3) the capital set free from projects now obsolescent, and (4) the diversion of capital that has gone abroad or might otherwise have gone abroad. Although the last is only one source, there is no reason why it should not be tapped.

The answer to the second question is that in our argument the marginal productivity schedule does not shift upwards autonomously but its shift is the result of the coordinated investment plans.[1] In the absence of such coordination, no such rise is to be expected and investment will not take place. In order to create the conditions of high domestic profits, the opportunities have first to be created. The fact that afterwards private investment will be attracted and will be diverted from foreign countries to the home country is an additional gain from the initial act of intervention.

The answer to the third question is more difficult. Clearly, the cumulative process may proceed more successfully abroad and the profits thus earned, as well as any improvement in the terms of trade (see next section), may benefit the investing country more than if the capital had been forced to stay at home. But it is probable that many of the ancillary activities clustering round the centre of growth will be conducted by foreigners abroad and benefit them if the investment is located there. Nevertheless, investing countries can substantially and cumulatively benefit from investment abroad, and host countries can become cumulatively dependent on foreign capital, with unfavourable net long-run consequences to themselves, as Canada and pre-1929 Germany have shown.

IV

Bottlenecks and the Locus of Investment[2]

A particular instance of cost-reducing investment is that which breaks a bottleneck. Although highly profitable for a time, it raises profits on all under-utilised productive capacity and in all those lines where the exploitation of economies of scale was restricted before. It is therefore misleading to assume in this context capital/output ratios constant for increments in investment. Once equilibrium is disturbed, the heterogeneity of the various pieces of capital equipment becomes crucial. Specific pieces are complementary with other pieces and with other resources. Investment is attracted into high-yielding lines, but high yield is an index of specific scarcity. By removing this scarcity, capital/output ratios in other lines are reduced and expansion is stimulated. But expansion creates new bottlenecks and new profit opportunities. This zigzagging path of the capital/output ratio is part of the process of expansion and affects the notional ' long-term equilibrium ratio ' towards which the process tends.

It is impossible to derive the capital/output ratio for a specific foreign project from prevailing capital/output ratios in the foreign country. This notion, once the long-term equilibrium path is left, has no significance.

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[1] This is analogous to the ' balanced growth ' argument in underdeveloped areas. The growth can, of course, be triggered off by an unbalance. The belief that other investment is being undertaken, creating markets, will induce imitation. Thus the existence of an overall plan might speed growth even in an economy not subject to central planning. The success of the so-called Vanoni Plan can be attributed to this fact.

[2] See MacDougall, section VI.

Investment will be biased in favour of high profit projects. Profits may be high because competition is imperfect, because the industry is highly protected and domestic rivals inefficient, because the foreign firm has special advantages, such as advanced know-how or patents, or because an expanding world demand meets the inelastic supply of wells, mines or plantations. If profits are high and likely to remain so for any of these reasons, the prevailing marginal productivity of capital gives no clue to the profitability of single ventures. The marginal productivity curve is not a continuous function. If, on the other hand, investment is in a competitive industry, or if, though initially high, profits are soon competed or taxed away, profitability will be low and will fall short of total social productivity.[1]

A partial remedy for the inability of an investor to reap the whole product resulting from his investment is full integration of industry, so that pecuniary advantages accruing to any sector accrue to the whole. But even if the economy were organised as one giant firm, profits need not reflect the full benefit, for, as we have seen, some of the net increase in production is passed on in the form of higher wages.[2]

V

Terms of Trade[3]

Foreign investment will increase the production of goods abroad above what it would otherwise have been, domestic investment will do the same at home. There is a presumption that external pecuniary economies discussed in previous sections will accrue to foreigners from the foreign investment, to nationals from the domestic investment. But this need not be so if we allow for changing terms of trade.

There are four sectors in which the divergence between national and private (or world) interest may be particularly important: domestic investment in exports and import substitutes and investment of domestic capital abroad in the investing country's imports and export substitutes. Investment that reduces directly or indirectly the costs of exports and foreign export substitutes generates pecuniary external economies abroad, whilst investment that reduces directly or indirectly the costs of imports and domestic import substitutes (though other countries' importers share this benefit) generates these at home. (For industries making complements to exports at home and complements to import substitutes abroad the opposite is true.)

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[1] It should, however, be noted that a substantial excess of domestic returns over interest or profits remitted abroad is not necessarily an argument for attracting foreign capital. The successful servicing of loans and equity investment does not depend only on the host country but also on the demand and supply pattern and on the policies pursued by the investor's country. Attempts to repay may be frustrated and deflation forced on the remitting country, as post-1929 experience has shown.

[2] The diffusion of gains and the necessity for privately unprofitable investments or of simultaneous action, discussed in the last two sections, represent inherent disadvantages of an economic system in which decision-taking is left to numerous independent individuals.

[3] Mr. A. E. Jasay in an article ' The Social Choice between Home and Overseas Investment ' (*E.J.* March 1960) assumes (1) that investment abroad will, directly or indirectly, improve the investing country's terms of trade, (2) that domestic investment will not alter the terms of trade with the rest of the world, and (3) that domestic investment will leave the marginal productivity curve unchanged. There appears to be no presumption for the nature, the direction or the extent of the shifts of the marginal productivity lines illustrated on his diagram.

Can one therefore say that British investment abroad that raises the production of goods Britain imports should be encouraged, while that which raises the production of products competitive with British exports should be discouraged? Unfortunately, no such simple conclusion is possible, for it depends, apart from all other complications such as the transfer problem, also on what would have happened to exports had it not been for the investment abroad. If foreign countries are determined to produce substitutes for British exports, either themselves or by inviting American or European firms to establish subsidiaries, it is better for Britain to replace her own exports by putting up subsidiaries abroad, than to cling to a doomed position. Moreover, the firms producing substitutes for exports abroad will require components from Britain and will generally have closer trade links, and might thus salvage the investing country's terms of trade.

It follows that, in deciding upon the optimum policy for investment abroad from a national point of view, it is not sufficient to consider the direct and indirect effects of investment upon the terms of trade compared with the current situation. The autonomous trend of the terms of trade must also be taken into account.

The important effects of foreign investment on the terms of trade through the consequential international transfer problems are too complicated to be treated here. One would have to distinguish between

(i) the transfer on capital account and the transfer of interest and dividends on current account; on capital account one would have to distinguish between (*a*) autonomous foreign investment, which involves a transfer problem, and (*b*) trade-induced investment (credit is given in order to promote export sales, or to finance an existing export surplus) and investment-induced trade (tied loans, direct investment by subsidiaries), neither of which involves a transfer problem on capital account, and both of which may give rise to ' negative ' transfer problems, when the complementary demands of the foreign country exceed the loan;

(ii) the various *methods* of correcting an imbalance (whether they worsen or improve the terms of trade; how one country's action is met by others);

(iii) the *types* of foreign investment undertaken, i.e. whether financial (equity or fixed interest) or direct;

(iv) the various patterns of supply and demand that arise from the investment and determine the response to whatever methods of correction are chosen (i.e. income and price ' elasticities ').

It is plain that no presumption about the comparative movement in the terms of trade resulting from an act of foreign or domestic investment can be established. We cannot even say that the primary will be stronger than the secondary effects. Thus, on current account, a deterioration of the investing country's terms of trade from its investing abroad, in say, export substitutes can be more than offset by the improvement resulting from the remittance of profits, and an improvement from its investing abroad in imports can be more than offset by the deterioration resulting from foreign tariffs imposed in order to remit profits.

VI

Investment and Employment

If there is general unemployment of men and machines, the national costs of a domestic investment project are substantially below the private costs. The social benefit is greater than profits by the additional wages (minus any unemployment relief) whereas investment abroad yields profits only. It is, of course, true that additional domestic investment in these conditions does not require a cut of foreign investment. Nevertheless, private profit considerations unaided by a full employment policy, may lead to socially excessive investment abroad. In conditions of Keynesian full employment the question arises whether the government is able to maintain full employment in all circumstances, or whether its ability depends upon (*a*) the provision of equipment (rigid techniques) or (*b*) the absorption of labour at ruling wage rates (rigid wage rates). Thus if there is an increase in the working population either through immigration or through natural population increase, or if more labour is set free by labour-saving inventions than can be re-employed by the rise in production, the maintenance of full employment may depend upon the provision of additional machines or upon reduction in wage rates. If in the absence of these provisions ' non-employment ' (distinct from ' unemployment ') would rise, national benefits from domestic investment exceed profits.

A special problem arises if the economy is divided into two sectors—one with rigid wages (downwards) and machines (industrial sector), the other with flexible incomes and no machines (rural sector). Full employment is always maintained, but productivity in the flexible income sector is below that in the rigid wage sector, and absorption of labour in the rigid wage sector is limited by available machines or merely by the relative dearness of labour.[1] Once again profits from investment in the rigid wage sector understate the national benefit. The wages received by the newly employed exceed their maginal productivity in the rural sector and this excess should be added to national gains.

This last case presents an extreme example of a more general phenomenon. A specific act of investment might raise the average productivity of labour

[1] Cf. MacDougall, p. 210.

in the economy as a whole for any *given* amount of capital, because it permits a move from low-to high-productivity occupations, because it shifts demand from low- to high-productivity goods, because it improves skills, because it makes workers more 'productivity-minded', etc. In all these cases national gains will exceed interest and profits.[1]

On the other hand, there are certain national advantages of direct investment abroad. Thus a large firm may be able to reduce costs more drastically when demand recedes by laying off workers and shutting down factories abroad than at home, where the government may exercise greater pressure and a sense of national responsibility may temper the profit motive. There is evidence for this in U.S. investment in Canada, and the same might happen here.

VII

Policy Issues

There are certain advantages and disadvantages of investing abroad which arise from the fact that it makes possible or necessary the pursuit of policies that otherwise would not have been possible or necessary. Thus foreign investment normally enables a country to exert pressures of various kinds to promote sales of exports. This may be the result of trade agreements, of tying sales to loans, of the psychological links forged by credit, or of the more direct links of foreign subsidiaries with their parent companies. Some hope and others fear that foreign investment may give the investing country political control.

On the other hand, if the foreign private investment (or, for that matter, government aid) is unstable, it requires frequent adjustments in the balance of payments of the receiving country. If this means that this country must maintain larger holdings of liquid international reserves than would otherwise be necessary, a loss of yield results. However, if reserves were not reinforced under such conditions, while devaluation is ruled out as ineffective or undesirable and balancing loans are not available, deflation would have to be applied with a loss of employment and production. Thus both holding additional reserves and not reinforcing them have for the recipient country serious drawbacks, which reduce the favourable effects of capital imports. Exchange rate variations are inappropriate for short-term adjustments and, even if effective, have drawbacks of their own. It is true that these disadvantages result not from foreign investment as such but from its instability. But foreign investment is notoriously unstable.

The disadvantages to recipient countries are most apparent when lending abroad and borrowing from abroad are used as buffers to absorb shocks on the domestic economy.[2] When other methods of adjustment between domestic wage and price targets on the one hand and savings and investment targets on the other are ruled out, foreign capital movements could be used to maintain high employment levels without inflation. Thus an excess of domestic attempted savings over domestic investment at full employment can be steered abroad through foreign loans, whilst a deficiency can be the occasion for borrowing from abroad. On these assumptions, foreign investment or borrowing abroad becomes the *only* means of maintaining full employment without inflation. The situation is analogous to that of regional adjustments within countries, except that there is no unified international capital market. If no international monetary and fiscal policies for stabilisation are pursued, a country that has foresworn all other measures of adjustment can thus shift the burden of instability onto foreigners. But borrowing from and lending to foreigners must not be advocated in order to maintain employment and stability. It would become necessary only because the policy makers in the country had ruled out all policy alternatives other than global monetary controls and the latter had failed to work. If this 'export of instability' abroad is managed well and in close cooperation with the countries which are recipients of the excess of exports or suppliers of the imports, it might not be destructive to balance abroad.[1]

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[1] The extent of improvement resulting from investment will depend also on the intensity of research and the energy with which it is applied.

[2] This is particularly dangerous for short-term capital movements with which we are not concerned here.

In some cases government policy can reduce or remove what appear to be high private costs of foreign investment. Foreign investors probably systematically overestimate the risks of investment in capital-poor countries. This may be the result of greater ignorance, fear of the strange or of political events, or illiquidity. Profits before risk allowances will tend to be high. Special tax concessions may increase them further. Actual net private profits from such investments will tend to exceed expected private profits after risk discount. If the investor's government were to stimulate this kind of investment by providing information, guarantees, participation, etc., profits, national gains and gains for the host country may all go up.[2]

The present system of double taxation agreements yields taxes on profits from overseas investment to the foreign country, and only the excess of domestic over foreign income or profits taxes to the home country. Domestic investment yields its full tax harvest to the home country. The overseas trade concessions introduced in 1957 have removed even this excess for the undistributed part of the profits of overseas trade corporations. Most advanced countries make similar concessions. When governments of underdeveloped countries attempt to attract capital by waiving taxation on foreign capital, the investor in these circumstances compares the yield *gross of taxation abroad* with *net* yield *after taxes at home.*

[1] It was in fact advocated as a means of stabilising the world economy by plans worked out at the Institute of Statistics during the last war (*New Plans for International Trade*, Oxford 1943).

[2] In many European countries, on the other hand, there are other and more important obstacles to foreign investment than the comparison of private yields. Apart from the deterrents of government regulations and different institutional arrangements, many companies have taken action to prevent large blocks of shares from falling into foreign hands. Intended to prevent take-over bids, these actions also reduce passive participation of foreign investors in any other than the few top companies. See article IX in the series of articles in *The Times*, 'Europe's Recovery', March 11th, 1960.

VIII

Conclusions

Once the assumptions of perfect competition, divisibility of factors and products, diminishing marginal productivity of capital, constant terms of trade and adjustments to equilibrium positions, are abandoned, it is impossible to say with certainty whether, from a national point of view, investing abroad is preferable to investing at home, or whether foreign capital should be attracted into or kept out of a country. Much depends on the industries and the conditions in which the investment takes place.

The traditional rules of the intellectual game, on which the traditional diagrammatical set-up is based, assume:

(*a*) decreasing returns and increasing costs throughout;

(*b*) existence of a long-term stable equilibrium which is seldom basically altered and which is disturbed mainly by once-for-all changes which do not necessarily change the eventual equilibrium position; and (possibly)

(*c*) shifts in these curves (with unaltered shape) as a result of improvement in technical knowledge.

In point of fact:

(i) The existence of decreasing returns is based upon a *cet. par.* assumption which is difficult to verify. All that is shown by experience is a process of improvement interrupted by periodic fluctuations.

(ii) The position at any given time is not one of ' equilibrium ' and none can in fact come about as changes are continual and adjustments take time. These changes alter the volume and composition of output. They also continually alter the ' position of eventual equilibrium ' (i.e. the position of balance which would be established if no further changes took place). Thus no position of ' eventual equilibrium ' will in actual fact ever be reached. The diagrammatical analysis understates, therefore, the importance in development of the locus of investment and the cumulative nature of certain strategic projects. The 'shift ' of the ' curves ' (i.e. the movement from one point to another) may itself depend on coordinated investment plans for which capital that would otherwise have gone abroad, or can be repatriated from abroad, is needed.

The attractiveness of investing abroad for a capital exporting country will depend on whether it takes the form of direct investment, portfolio investment or fixed-interest lending, whether the investment is autonomous or trade-induced, and into what industries, and areas, it moves. Unless the direct and indirect yields of investment abroad are very high, there is some presumption that, from a national point of view, domestic investment is preferable at the margin.

In a fully developed country an increase in foreign-owned capital may have unfavourable effects, unless it occurs in a competitive industry, unless it raises the productivity of labour for a given amount of other resources, or unless technical knowledge and experience are diffused from foreign firms to the rest of the economy. It must, however, be remembered that even the most favourable conditions for attracting capital from abroad can be more than offset by the difficulties created by transferring the ensuing profits or interest to the investing country. Unless this transfer is facilitated by the policies of both investing and receiving countries, attracting capital from abroad for purposes which do not directly or indirectly assist the transfer might detrimentally affect the balance and the terms of trade.

In underdeveloped areas where employment is limited by capital shortage, i.e. where there is non-employment or rural underemployment, the addition to national income will be larger than if the labour force were fixed or if productivity were equal in all lines. On the other hand, the increase in foreign profits might be dramatic. It is also possible that the cosmopolitan interest might be better served if the fully developed country invested at home, increased its rate of growth, taxed an (increasing) portion of the ensuing gain and redistributed it by free grants.

The presumption that domestic investment yields greater external economies to the investing country than investment abroad is insufficient to justify drastic curtailment of foreign investment or the general encouragement to the entry of foreign capital from abroad. It constitutes a case for control of capital exports (and, indeed, for both control and promotion of domestic investment projects) and of foreign participation in domestic investment. This control could be used to prevent excessive capital export in order to avoid a sharp deterioration of the terms of trade in a period of stress, and deflationary action at home. While all definite judgment in these matters seems dangerous, there is also a presumption that capital imports which are large in relation to domestic savings should be avoided as they might lead to a subsequent sharp deterioration of the balance of payments and the terms of trade.

None of the foregoing should be taken to imply that the national economic interest can be identified either with the national general interest or the social interest. Capital exports can be used for political or economic warfare,[1] and for philanthropy. To contribute towards the raising of the standard of living in poor countries is our specific duty as members of the British Commonwealth, and our general duty as members of the commonwealth of men.

Balliol College

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[1] The fact that economic sacrifices can be used for political gains, and that economic gains can involve political losses, is illustrated by Nazi Germany's economic policy in Eastern Europe.

AN ANGLO-AMERICAN COMPARISON OF PERSONAL SAVING

By JOHN B. LANSING *and* HAROLD LYDALL

In a previous paper [17] the present authors undertook a comparison of the distributions of personal income and wealth in the United States and Great Britain. This paper is a continuation of that study, the spotlight now being turned on personal saving.

In spite of progress in recent years, the behaviour of saving is still very largely a mystery. Keynes, who first brought the propensity to save into the centre of discussion, assumed that, since rich men save a higher proportion of their incomes than poor men, rich nations would save a higher proportion of their incomes than poor nations. Moreover, the same nation could be expected to save a larger share of its income when its real per capita income rose than when it fell. This reasoning was assumed to apply not only in the short run—over the range of the trade cycle—but also in the long run. Hence he deduced that there was a grave risk that fully developed economies would suffer from secular stagnation.

Statistical studies of the United States economy in the inter-war years appeared to provide confirmation of these assumptions, at least in relation to short-term fluctuations of income. But when Kuznets [15, p. 53] produced figures to show that the average saving-ratio in the United States had remained fairly constant from 1869 to 1929, followed by a substantial decline in the 1930s, serious doubt was cast on the Keynesian assumption in its long-term application.[1] A notable effort to overcome this difficulty was made by Duesenberry [4], using a combination of a relative-income hypothesis to explain the cross-section data (which was suggested independently by Brady and Rose Friedman [3]) and a non-reversibility condition for historical changes, current consumption being determined by the relation between current income and the highest previous level of income (which was also suggested independently by Modigliani [28]).

Over the past ten years a very large number of models of the consumption function have been suggested and tested. One of the most important discoveries made in this process was that the introduction of a liquid asset variable would improve the fit of the regression equation of consumption on income (whether current or lagged).[2] These models were not so much in contradiction to the earlier hypotheses of Keynes or Duesenberry as in elaboration of them.

In 1957, however, the cat was once more set amongst the pigeons by

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[1] Kuznets' findings refer strictly to the ratio of total saving to income, but essentially the same pattern appears in Goldsmith's subsequent estimates of the personal saving ratio [10, p. 76].

[2] See, for example, Klein [13] and reviews of consumption studies by Ferber [5], Zellner [37] and Suits [32].

Milton Friedman with his *Theory of the Consumption Function* [8]. Friedman's explanation of the conflict between (1) the upward slope of the saving-ratio revealed by both cross-section and cyclical time-series data and (2) the long-period stability of the saving-ratio in the United States is that the former observations are illusory. Maintaining that the 'measured' income of a single year is not a proper indicator of the economic position either of an individual or of a nation, he proceeds to the extreme assumption that the 'true' saving-income regression is that which obtains over the long run, namely a straight line through the origin, with saving (or consumption) equiproportionate at each level of 'permanent' income. This is certainly standing Keynes on his head!

It is not our intention in this paper to devote special attention to this new theory, which we consider to be, in its extreme form, both intuitively implausible and empirically untenable. There is, however, an element of truth in Friedman's view that the income of a household for a single year gives an incomplete picture of its economic status. Households, like other economic entities, are subject to random shocks, and even perhaps to cyclical fluctuations in fortune, and their behaviour may, in some cases, be more adjusted to their underlying trend position than to their momentary experience. This hypothesis is particularly appropriate to the case of self-employed farmers and businessmen, whose income necessarily fluctuates more widely from year to year than the income of employees or of persons living on the yield of property. We have found from surveys of savings that it is common practice amongst the self-employed to take out of their businesses a relatively fixed amount of spending money, irrespective of the week-to-week or month-to-month fluctuations in their profits. The effect of this practice is that the savings of the self-employed are largely a residual out of current income, after subtraction of a trend-determined volume of consumption expenditure. This undoubtedly accounts for a large part of the slope of the cross-section regression of saving on income for the self-employed (which, as we shall see, is substantially steeper than a similar regression for other spending units).

Our main purpose in this paper is not to test, nor to substantiate, any particular theory. But while we are studying the facts we shall keep in mind the various existing theories of saving, and we shall hope to use the facts to discriminate to some degree amongst them. It should not be surprising, also, if a careful study of the facts suggests new hypotheses.

A word of explanation may be necessary about the definition of 'personal' saving. The personal sector is defined in this study, as in national accounts, to include households, non-corporate enterprises and non-profit institutions. Personal saving, therefore, includes (1) 'visible' savings out of wages, salaries and other cash incomes of households, (2) retained profits of non-corporate businesses, and (3) increases in the funds of life insurance companies, pension schemes and other private trusts. It is sometimes suggested that the retained profits of non-corporate businesses should be shown separately from the saving of the purely personal sector; but this is unfortunately impossible, not only in practice but in principle, since a non-corporate business (unless it is a partnership) does not have a separate personality from its owner, so that any attempt to split one from the other is inevitably a fiction.

We have tried to apply the accepted definition of the personal sector consistently throughout our analysis, whether of national accounts or of survey material, but, as will be seen below, we were faced by some intractable problems. One of these is the method of handling government retirement funds, which are often not kept on a strictly actuarial basis. Another is that the household surveys were unable to collect complete information about changes in individual interests in life insurance and pension funds. The survey data on this aspect cover only each spending unit's own contributions to these funds, minus any lump sum receipts; they exclude the contributions made by employers, the funds' income from investments, current benefits paid and the costs of operation. The implications of these omissions will be discussed in detail in their proper place.

The arrangement of our inquiry is as follows. First, we shall examine the evidence from the time series. In the United States quite impressive time series figures are available for pre-war years—official estimates from 1929 and unofficial estimates from 1897 or even earlier. But no similar figures have yet been prepared for the United Kingdom. We have therefore limited our comparison of these data to the post-war period, for the most part to the years 1948–1958. Secondly, we shall turn to the surveys. In the United States estimates of saving were made by the Surveys of Consumer Finances for the years 1948, 1949 and 1950. In Britain the Savings Surveys collected similar data on four occasions between 1952 and 1955. For reasons which will be explained below we have chosen to compare the American data for 1950 with the British data for 1953–4. Finally, we shall draw together the lessons which emerge from the two types of comparison and suggest some general conclusions about the factors determining the volume of personal saving in each country.

I. THE TIME-SERIES COMPARISON

Statistical Adjustments

The primary data used in this comparison are the official estimates of national income and its components [29, 31, 36]. Details of the exact series employed are given in Appendix I. The concepts used in the British and American national accounts are very largely standardized, so that only minor modifications are necessary in order to arrive at reasonably comparable estimates of personal saving.

The most important difference between the countries lies in the treatment of depreciation, an item which is, in any case, scarcely amenable to complete standardization. The United States figures of depreciation are based on the accounting provisions actually made by businesses, except in the case of agriculture, where an estimate of replacement cost depreciation is made centrally. In the United Kingdom the national accounts are generally shown gross of depreciation, but estimates are also given of capital consumption at replacement cost. For a comparison of the two countries we may either work with gross figures—which are possibly preferable on other grounds—or we may adjust both countries' figures by subtracting estimated depreciation at replacement cost. For this latter purpose Dr. Raymond Goldsmith has kindly given us his estimates of replacement cost depreciation in the United States in the period 1948–58.

The second important problem is how to treat government retirement funds. These are of three main types. First, there are social security funds, accumulated for the benefit of wide classes of the population. Secondly, there are retirement funds accumulated on behalf of central government employees. Thirdly, there are retirement funds for local and State government employees. In the official United States accounts none of these funds is included in the personal sector and all saving through increases in these funds is attributed to the government. In the United Kingdom changes in the social security funds are treated similarly, but changes in local government pension funds are included in personal savings. The central government in Britain has no retirement fund for its own employees, their pensions being paid, as they arise, out of current revenue. We should have preferred to bring all increases in personal assets into the reckoning of personal saving. This would mean making annual estimates of the accrued liabilities of the British and American governments both to potential social security beneficiaries and to their own employees. (Although the American federal government keeps a retirement fund for its employees, the fund is not maintained at its full actuarial level.) Since this would be an extremely difficult exercise in economic and actuarial computation we were obliged, on practical grounds, to limit ourselves to including only the local and State government retirement funds in the personal sector. Estimates of the changes in these funds in the United States have been kindly provided by the Department of Commerce and we have adjusted the U.S. estimates of personal income and saving accordingly.

Three minor modifications have also been made to the British estimates of personal saving. First, in the United Kingdom but not in the United States, the official estimates of personal investment in real estate include the value of dealers' commissions, legal charges, and other transfer costs. It is doubtful whether such costs should be included in personal saving and, since they are in any case not separately available for the United States, they were excluded from the United Kingdom estimates of saving and income. Second, in the United Kingdom national accounts war damage repairs payments are treated—somewhat illogically—as a capital transfer from the government to the personal sector to reimburse a current expense, thereby reducing personal saving below what it would be in the absence of such expenditure. We have added back these payments to personal saving. Third, in the United

Kingdom the farm income of limited liability companies—a small item—is included in personal income, and thereby in personal saving. We have deducted estimates for this item from both personal income and saving for the years covered by our analysis.

International comparisons are usually complicated by the fact that values are expressed in different currencies. In the case of saving, however, the most interesting comparisons are those that can be made between saving-ratios (saving expressed as a percentage of income). In this way we eliminate the *numéraire.*

Analysis of the Adjusted Data

What, we may ask ourselves, should we expect the relative sizes of the American and British saving-ratios to be? In terms of real income per head the United States population is much better off than the British (according to the best estimates available average real income is from 50 to 100 per cent higher in the U.S. than in Britain [9]). On the Keynesian hypothesis this should lead us to expect a substantially higher personal saving-ratio in the United States. On the Duesenberry or Friedman hypotheses, however, there would be no special reason on these grounds to expect the American personal saving-ratio to be higher than the British; nor would it necessarily be any lower.

The overall gross and net saving-ratios for each country for 1948–58 are given in Table I. Both series exhibit a common feature, namely, that whereas the U.S. ratios have stood at approximately the same level since 1951—about 12 per cent gross and 7–7½ per cent net—the British ratios continued to rise until 1956. Since 1956 the British ratios have levelled off—at about 8 per cent gross and 6 per cent net. But we cannot be certain that the British ratios will continue at their present height, as the U.S. ratios have done since 1951. The British ratios ran along a plateau once before—from 1952 to 1955—at a somewhat lower level, and it is quite possible that this new plateau is also only temporary. It is clearly impossible to forecast the future movement of the ratios in either country without the help of a theory of saving.

Let us, therefore, consider whether the figures in Table I are consistent with any of the three main theories of saving. In so far as they show a lower saving-ratio in Britain than in the United States, and a rising trend in the British ratio, they are consistent with Keynesian theory; but in so far as the U.S. series has no upward trend after 1951 they are not. (Both U.S. and British real per capita incomes had a rising trend throughout this period.) The Duesenberry hypothesis could probably account for the U.S. series fairly well, and it might be invoked to explain the jump in the British ratio in 1952, when British per capita real income first recovered to its pre-war level [19, pp. 22–25]. But it would be unable to offer any rational explanation of the further rise in the British ratio in 1956.[1] Finally, we doubt whether all the data in Table I can be fitted into the Friedman theory—elastic though that theory has proved to be. If we postulate that the proportion of ' permanent ' income consumed is the same in both countries—and there is no special reason in the Friedman approach why it should not be—then the data are evidently inconsistent with the theory, unless we assume that the British public believed throughout the years 1948–58 that their current income was below their ' permanent ' income. But, in that case, why should not American citizens have held the same view? They would have had at least as good reason as the British to expect an upward trend in their real incomes. Provisionally, perhaps, the Keynesian theory comes out best from this simple comparison. But it will be better to reserve judgment on these issues until more evidence has been presented.

TABLE I

Gross and Net Personal Saving-Ratios, United States and United Kingdom
(Percentages of disposable income)

	Gross saving-ratio[1]		*Net saving-ratio*[2]	
	U.S.	*U.K.*	*U.S.*	*U.K.*
1948	9.4	0.3	5.0	−2.2
1949	8.7	1.8	3.9	−0.6
1950	10.3	1.4	5.6	−1.0
1951	12.0	1.0	7.3	−1.6
1952	12.3	5.6	7.5	3.1
1953	12.2	5.8	7.4	3.4
1954	11.9	4.2	7.0	1.8
1955	10.9	5.6	6.0	3.4
1956	12.3	7.7	7.4	5.6
1957	12.1	8.3	7.2	6.2
1958	12.2	7.9	7.1	5.8

[1] Saving and disposable income are gross of depreciation but after inventory revaluation adjustment.

[2] Saving and disposable income are net of depreciation at estimated replacement cost.

Sources: See Appendix, I.

In passing, it should be noted that on a net basis the American and British ratios are closer to one another than on a gross basis. The reason for this is that in the United States a larger proportion of all business and residential property is owned directly by persons (including non-corporate businesses) than in Britain. Parallel with this, a greater percentage of American spending units own business or residential property (especially their own homes) than is the case in Britain [17, p. 62].

Table II gives a breakdown of each country's gross saving-ratio into five major components. (More detail than this is available for the U.S. but not much more for the U.K.). As we might expect, for the reasons just given, American personal investment in houses and non-corporate business assets

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[1] It could, of course, he suggested that the British ratio rose in 1952 because of the return of a Conservative Government in 1951, or because of that government's resort to a policy of higher interest rates. Similarly, the Conservatives were returned for a second time in 1955, and again interest rates were raised. But we are inclined to regard these events as coincidental rather than causal. There is no evidence that the increase in interest rates in the U.S. in recent years has been accompanied by a rise in the personal saving-ratio.

TABLE II

Major Components of Gross Personal Saving, United States and United Kingdom
(Percentages of gross personal disposable income)

	Gross Physical Investment in:				*Changes in Liquid Assets*[1]		*Changes in Life Insurance & Pension Funds*[2]		*Changes in Other Assets and Liabilities*	
	Houses		*Non-corporate Enterprises and Farms*							
	U.S.	*U.K.*	*U.S.*	*U.K.*	*U.S.*	*U.K.*	*U.S.*	*U.K.*	*U.S.*	*U.K.*
1948	5.0	0.5	6.3	2.1	0.5	1.9	2.3	2.6	−4.8	−6.8
1949	4.8	0.6	4.5	2.0	0.8	1.5	2.4	2.6	−3.8	−4.9
1950	6.5	0.5	6.3	2.2	2.5	0.9	2.5	2.9	−7.6	−5.1
1951	5.5	0.6	5.5	2.4	3.2	0.7	2.6	3.1	−4.8	−5.8
1952	5.3	0.9	4.7	1.4	4.1	0.9	2.9	3.1	−4.8	−0.7
1953	5.4	1.4	4.2	1.8	3.3	1.6	2.9	3.2	−3.7	−2.2
1954	6.0	1.8	4.3	2.1	3.9	3.0	3.1	3.4	−5.3	−6.1
1955	6.7	1.9	4.7	2.2	3.1	2.2	3.0	3.4	−6.6	−4.1
1956	6.0	1.9	4.1	2.0	3.2	2.2	3.0	3.4	−4.0	−1.8
1957	5.6	1.8	4.0	2.2	2.6	2.5	2.9	3.7	−2.9	−1.9
1958	5.7	1.9	3.9	2.2	4.9	2.6	3.0	3.9	−5.3	−2.7

[1] Liquid assets include: in the U.S., currency and bank deposits, shares in savings and loan associations, and U.S. savings bonds; in the U.K., bank deposits (but not currency), building society shares and deposits, and National Savings (deposits in savings banks, National Saving Certificates and Defence Bonds).

[2] Private insurance and pension funds plus local and State government retirement funds. Central government funds are excluded.

Sources: See Appendix I.

is greater than British. For houses, the gross U.S. figure has been running for several years in the region of 6 per cent of gross disposable income, while the British figure is not more than 2 per cent. For non-corporate businesses and farms the American figure is about 4 per cent against about 2 per cent in Britain. On a net basis, of course, the gaps between these pairs of figures would be substantially reduced. Moreover, if we were to subtract from personal investment in houses the funds raised by persons on mortgage loans we should again reduce the gap between the American and British figures. In the U.S. such loans have been increasing by an average of about 3 per cent of gross disposable income each year compared with about one per cent in Britain. (These loans are included in the residual item in Table II.)

Increases in liquid assets, on the whole, take a larger share of disposable income in the United States than in Britain, averaging in recent years about 3½ per cent against about 2½ per cent. If changes in currency holdings were excluded from the U.S. figures (as they are from the British figures) the U.S. figures would be practically unchanged.[1] On the other hand, increases in the funds of life insurance and pension schemes (private plus local and State government, but not central government, schemes) are greater in Britain than in the United States. The margin is not large, but it appears to be increasing. The reasons for this phenomenon are not entirely clear; but it may be connected with the fact that life insurance premiums and employees' contributions to pension funds are partly or wholly tax exempt in Great Britain while being fully taxable in the U.S.

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[1] It should be noted that the proportion of total net saving represented by changes in liquid assets has been about the same in both countries in recent years.

The residual item includes—besides the changes in mortgage loans already mentioned—all other changes in assets and liabilities, such as increases in instalment credit, net purchase of securities and land, and so on. Increases in consumer debt fluctuate widely from year to year in each country. In the United States they have averaged in recent years about one per cent of disposable income; in the United Kingdom (where figures for changes in instalment debt only are available and these only since 1955) they have been less than half as much, but it is likely that they will increase in the future.[1] Information about net personal purchase of securities is available for the United States but completely lacking in Britain. In the former country it fluctuates very widely from year to year, but over the period 1954–58 it has averaged about 1½ per cent of gross disposable income. It seems probable that the figure for the United Kingdom, if we knew it, would be smaller than this, or even negative. A possible reason for this is the greater divergence in Britain than in America between the degree of concentration of ownership of securities (and of property generally) and the degree of concentration of income [17].

This brief survey of the components of saving in the two countries shows some remarkable similarities (in liquid assets and in insurance and pension funds) and also some large differences (in physical investment and in changes in debt). The greater importance of physical investment in the U.S. suggests one possible reason for the greater size of the overall saving-ratio in that country; but we now wish to bring forward some other considerations which we believe to be important in determining this ratio.

First, it has been shown from several analyses of cross-section surveys, e.g. [20, pp. 161–2], that there is a negative correlation between saving—on the usual definition—and expenditure on durable goods (which, with the exception of houses, are excluded from saving). There is nothing surprising in this. To some degree one would expect to find a negative correlation between any two components of total outlay—and even more so if the components are expressed as percentages of the total. But the negative relation between saving and durable expenditures has a more obvious explanation even than that, namely, that one of the functions of a stock of savings is to take the shock of lumpy items of expenditure. Similarly, when the purchase of a durable good is financed by means of a loan, or by instalment credit, there is inevitably a close relation between the value of the good—recorded as expenditure—and the negative item entered in the spending unit's saving account. On the opposite side of the account, spending units who have not bought durable goods during a particular year will frequently be accumulating savings or repaying loans.

We have thought it useful, therefore, to examine the time-series relationship between saving and durable expenditures. In Table III the series for

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[1] For most of the latter part of the period reviewed instalment credit terms in Britain have been regulated by the government.

TABLE III

Savings, Consumer Durable Expenditures and Liquid Asset Holdings, United States and United Kingdom

(Percentages of gross personal disposable income)

	Major Consumer Durable Expenditures[1]		*Gross Saving Plus Durables*		*Net Saving Plus Durables*		*Liquid Assets at at Beginning of Year*[2]	
	U.S.	*U.K.*	*U.S.*	*U.K.*	*U.S.*	*U.K.*	*U.S.*	*U.K.*
1948	6.8	4.1	16.3	4.5	11.6	2.0	84.0	100.7
1949	7.9	4.6	16.6	6.4	11.6	4.0	83.9	97.1
1950	9.3	5.1	19.6	6.5	14.6	4.1	77.3	94.0
1951	7.9	5.4	19.9	6.4	14.8	3.9	72.7	88.2
1952	7.4	5.1	19.6	10.7	14.4	8.2	72.3	80.4
1953	8.3	5.9	20.5	11.8	15.4	9.3	72.2	76.6
1954	8.1	6.7	19.9	10.9	14.7	8.5	74.1	74.5
1955	9.5	7.0	20.4	12.7	15.3	10.3	73.0	71.2
1956	8.3	6.2	20.6	13.9	15.3	11.6	71.3	68.2
1957	8.2	6.5	20.4	14.8	15.0	12.5	70.8	66.6
1958	7.0	7.1	19.2	15.0	13.9	12.7	71.3	66.2

[1] Includes new and used cars, furniture, household appliances and radio, television and other electrical consumer goods.

[2] Liquid assets as defined in Table II.

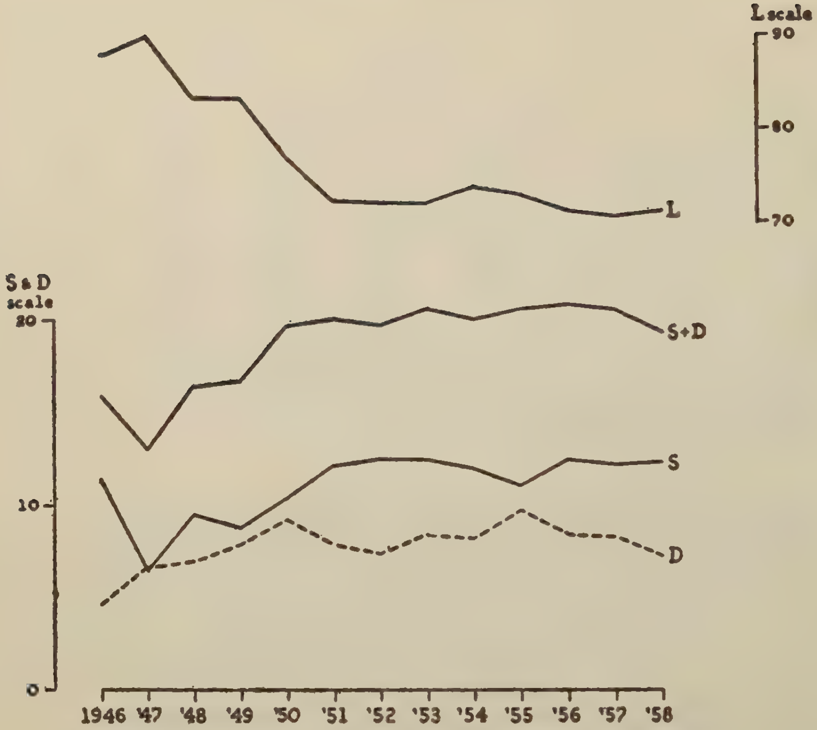
Sources: See Appendix I.

consumer durables is limited to major items, such as cars, furniture, household appliances and other electrical goods. (An exact definition, with sources of the data, can be found in Appendix I.) These are the main types of ' lumpy ' items which one would expect to affect savings in the ways suggested above. It is interesting to find that British expenditures on these items are not far below American expenditures, when expressed as percentages of disposable income. (In 1958 they were apparently slightly higher.) But the real volume of durables purchased per American family is, of course, much larger than the real volume per British family. And this for two reasons: first, because American real incomes are higher, and secondly, because durables are relatively cheaper, compared with other goods and services, in the United States than in Britain [9, p. 41].

As predicted, the fluctuations in the durable expenditure-ratio tend to be in the opposite direction to the fluctuations in the saving-ratio. Consequently, when the two ratios are added together the annual figures for the sum follow a smoother trend than the figures for the saving-ratio alone (see Charts 1 and 2). In the United States the S+D-ratio (S=gross personal saving, D= durable expenditures) has since 1950 moved steadily along a plateau, in the region of 20 per cent. In the United Kingdom the S+D-ratio has had an upward trend throughout the period 1948–58, with interruptions in 1950–51 and 1954, and with a tendency to level off in recent years at about 15 per cent. The fluctuations in 1950–52 were probably due, in part at least, to the scare buying of textiles and other ' non-durables ' in the first nine months after the outbreak of the Korean war, followed by an offsetting decline in such purchases in 1952.

Chart I

UNITED STATES



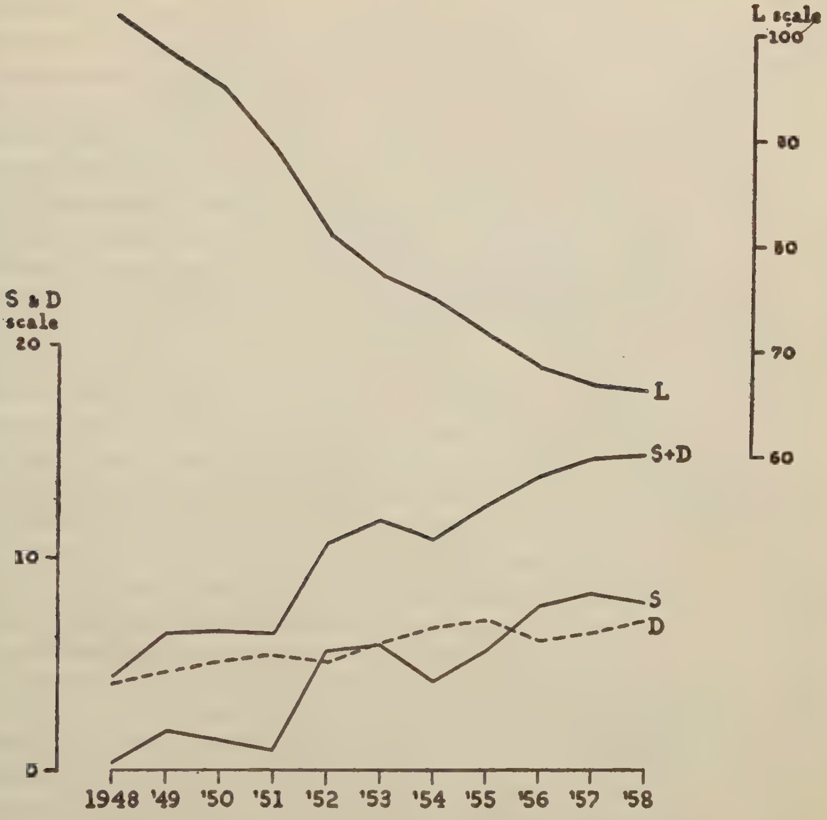
Gross Personal Saving (S), Durable Expenditures (D), and Liquid Asset Holdings (L) as per cent. of Gross Disposable Income.

The conclusion we draw from this part of our analysis is that one of the important determinants of personal saving, as normally defined, is consumer expenditure on major durables. Alternatively, saving and durable expenditure can be added together, as is recommended by various authors, e.g. [8, 10, 25, 26], and gross saving in this sense can be made the dependent variable. In principle, an adjustment should be made for depreciation of the existing stock of durable goods, but in practice this is difficult to do satisfactorily. In any case, year-to-year fluctuations in durable expenditures are not mainly attributable to changes in depreciation, and the gross figure for saving plus durable expenditure can usefully be regarded as the variable that needs explaining.

The second step in our attempt to explain saving behaviour in the United States and Britain is to relate the S+D-ratio to the stock of personally held liquid assets. The reasoning behind this is as follows. The amount of gross saving (S+D) set aside each year by a family will depend on various

Chart II

UNITED KINGDOM



Gross Personal Saving (S), Durable Expenditures (D), and Liquid Asset Holdings (L) as per cent. of Gross Disposable Income.

considerations, such as its income, its responsibilities (number of persons to be supported), and the age of the head (how soon he will have to retire). We shall see below that occupation, home ownership and other factors are also important. But one other consideration which is clearly very relevant is the existing stock of capital owned by the spending unit. If two men of the same age have equal income and family responsibilities, but one has a store of capital equal to five years' income and the other has only half as much, it would not be surprising to find that the first was saving a smaller proportion of his current income than the second. The same conclusion follows for changes in the individual's wealth-income ratio if we assume that the marginal utilities of current consumption and of a stock of capital are both diminishing.[1]

In the aggregate, therefore, for a population of a fairly constant demographic and occupational structure, it might be expected that the saving-income ratio and the wealth-income ratio would be inversely related. Annual estimates of aggregate personal net worth, which would be needed to test this hypothesis, are not at present available for either the United States or the United Kingdom. In their place we have experimented with the figures of personal liquid assets holdings, since there is evidence (from a cross-section survey) to suggest that the stock of personal liquid assets is largely governed by personal net worth [21]. This procedure may be more appropriate in Great Britain than in the United States, since in Britain liquid assets form a larger fraction of the total assets of consumers than in the United States [17], but in both countries the liquid asset holdings of consumers are substantial. The figures in the last two columns of Table III show the stock of personal liquid assets held at the beginning of each year as a percentage of gross disposable income during the year. (Liquid assets are defined in the same way as in the previous table.)

When the L-ratios are compared with the S+D-ratios (see Charts 1 and 2) they show a quite remarkable inverse relationship. In both countries the L-ratio rose rapidly during the war and immediate post-war years, reaching a peak about 1947 [19, p. 32]. Thereafter it gradually declined. In the United States the war-time rise had been smaller than in the U.K., so that by 1951 in the U.S. the L-ratio had returned to a point about 10 per cent above 1938. Here it levelled off. In the United Kingdom, on the other hand, the L-ratio continued to fall right through our period, though somewhat more slowly towards the end. By 1958 the British L-ratio was also approximately 10 per cent above its 1938 level. Meantime the changes in the S+D-ratio had approximately mirrored those of the L-ratio in each country.

It may be objected that the inverse relationship found between the S+D-ratio and the L-ratio is not so much a ' wealth effect ' as a ' liquid asset effect '. It is true that during the war there was a disproportionate increase in personal liquid asset holdings, so that by the end of the war the ratio of liquid assets to total personal wealth in both the United States and Britain was higher than it had ever been. But there is a good deal of evidence to suggest that this ratio made a permanent upward shift during the second world war, as it had already done during the first world war. In order to substantiate this view it would be necessary to have a series of estimates of the aggregate personal balance sheet in the post-war years, for both Britain and the United States. These are not at present available; but for Great Britain there are official figures showing the composition of estates subject to estate duty in the years since 1948–49. (These are the estates which exceeded £2,000 of net capital until 1954–55 and £3,000 thereafter, and they represent about 10 per cent of those who died in each year.) In the period 1948–49 to 1958–59 the proportion of cash and bank deposits (including savings bank deposits) to total capital in each range of capital in these estates remained remarkably stable. It is also noteworthy that—except in the years 1948 and 1949 in the United States—additions to liquid assets have continued throughout the period to constitute a substantial proportion of current net saving in both countries (see Tables I and II). In recent years, indeed, additions to liquid assets have represented about half of net personal saving in each country, which is a much higher proportion than the ratio of the stock of liquid assets to total personal wealth at any time since the end of the war.[1]

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[1] References to this proposition occur in the works of numerous authors, notably Modigliani, Brumberg and Ando [27, 2]. A negative relation between wealth and saving has also been suggested by—amongst others—Ackley [1], Tobin [33, 34], and—implicitly if not explicitly—by all the authors who have supported the ' Pigou effect ', including, of course, Pigou himself [30].

On the basis of general economic reasoning we prefer to believe that the operative influence on saving behaviour is the wealth-income ratio rather than the liquid asset-income ratio. This is one respect in which we differ from many of the authors who have previously studied the effect of liquid assets on saving.[2] We differ from others in the use of the S+D-ratio instead of the S-ratio as the dependent variable in this relationship.[3] It is clear from Chart 1 that the S+D-ratio is much more closely related (inversely) to the L-ratio than is the usual S-ratio.

We may summarise our hypothesis by saying that the S-ratio is determined by (1) the L-ratio—standing proxy for the wealth-income ratio—and (2) the division of S+D between S and D. Stated formally, the hypothesis is that

$$\begin{aligned}\frac{S}{Y} &\equiv \frac{S+D}{Y} - \frac{D}{Y}\\ &= a - b\frac{L}{Y} - \frac{D}{Y} + u\end{aligned}$$

where L=kW (W=aggregate personal net worth) and u is the error term. It is easy to show that this hypothesis can be used to account for both the short-term cyclical fluctuations in the saving-ratio and its longer-term stability.[4]

But even if we accept the above analysis, there remains one puzzling question: Why should the British S+D-ratio apparently be levelling off at a point below the equilibrium level of the American S+D-ratio? Is the answer to be found, once more, in the difference in real income levels? Or are there alternative explanations? One possibility is that the difference arises from a difference in the underlying demographic and occupational structure of the two populations. We have already observed that there are differences in saving propensities between people of different occupations, ages and so on. We therefore propose in the next section to examine these differences with the help of survey data and to see what light can be thrown by such an approach on the overall difference between the American and British saving-ratios.

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[1] It should be remembered, of course, that the ratio of liquid assets to total wealth is determined not only by the components of the flow of new saving but also by the changes in market values of non-liquid assets. A high ratio of liquid assets to current net saving may be consistent with a constant (lower) ratio of liquid asset holdings to total wealth if the average price of non-liquid assets is rising.

[2] Summaries of the results of these studies can be found in Ferber [5], Zellner [37] and Suits [32].

[3] Fisher [7] has used S+D as the dependent variable in many of his equations fitted to cross-section data.

[4] A fuller account of the implications of this hypothesis will be given in a separate publication.

II. The Cross-Section Comparison

Savings Surveys were made in Britain on four occasions between 1952 and 1955, but the last Survey of Consumer Finances to collect data on saving for the United States was that which covered the calendar year 1950. Since the comparisons to be made in this section are comparisons of structure, not of absolute levels, the particular years selected for study are not of primary importance. As we have seen, British saving was nearer to its 'normal' level in 1953 than in 1951. Hence it was decided to compare the U.S. survey of 1950 with the British survey of 1953–54. This latter survey refers to a twelve-month period ending about April 1954.

Although by 1953 the British saving-ratio had recovered somewhat from its post-war decline, on a gross basis it had still reached only about half the level of the U.S. ratio in 1950 (5.8 per cent compared with 10.3 per cent). The difference between the survey estimates of the saving-ratios for approximately the same years (1953–4 and 1950) is even wider (2.5 per cent in Britain against 8.6 per cent in the U.S.). The reasons for these differences between the estimates derived from the surveys and from the national accounts, and particularly for the wider gap between the two countries' survey estimates than between their national accounts estimates, are discussed in a note in Appendix II. The difference *within each country* between its survey estimate and its national accounts estimate is, of course, largely attributable to a difference in the definition of saving for each purpose (as well as to errors of measurement); but the differences in the width of the gap between the two estimates for each country are not mainly due to any difference of definition *between the countries*, but rather to a difference in the relative importance of the adjustment that has to be made to pass from the survey basis to the national accounts basis in each country. The main peculiarity of this adjustment is that the net amount to be added to the survey figure in respect of life insurance and pension fund saving is relatively greater in Britain than in the United States.

A study of the voluminous—though scattered—literature analysing the results of savings surveys in both the United States and Great Britain shows that four major factors influence the saving of a spending unit.[1] They are

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[1] A spending unit is, broadly, a group of persons who pool their incomes for their major items of expense. Details of the precise definitions of the spending unit used in each survey will be found in [17, pp. 50–51]. Descriptions of the methods employed in the two surveys will be found in [20] and [23].

(1) the income of the unit, (2) the occupation of the head (whether he is self-employed, an employee, or retired), (3) his age, or stage in the family life cycle, and (4) whether the unit owns its own home. The distributions of these factors—income, occupation, age or stage in the life cycle, and home ownership—may be called the ' structural ' characteristics of the population.

This list of factors which influence the saving of a spending unit could be extended. For example, in the cross-section studies there is evidence that spending units with large liquid asset holdings frequently use them to maintain consumption in the face of an income decline, especially if that decline is seen as temporary [11, 35]. We shall also argue that attention should be paid to the impact of participation in pension funds on total saving, and, more generally, that different types of saving may be imperfect substitutes for each other. Much of the recent empirical work emphasises the importance of consumer expenditure in explaining saving or fluctuations in saving [12, 22, 26]. The reasoning developed by these authors suggests that the consumer follows the example of the national income accountant and treats saving as a residual.

Previous research makes possible a rough ranking of the importance of the several independent variables in explaining the saving of individuals. Income and occupation are powerful variables; any analysis of survey data on saving must somehow take them into account. For many purposes age and home ownership must also be considered; a complete investigation should include these variables.

Our plan of analysis is as follows. First, we shall examine the overall distribution of saving-ratios in the two countries. Secondly, we shall consider the crude effect on saving of income and occupation. Thirdly, we shall take account of the influence of the life cycle and home ownership. We shall then make an experiment to see how far the gap between the American and British saving-ratios would be closed if the American population had the same structural characteristics as the British population. Finally, we shall make a few remarks about the importance of pension funds.

The Distribution of Saving-Ratios

The ratio of average survey saving per spending unit to average net income per spending unit was, as we have already noted, 8.6 per cent in the United States in 1950 and 2.5 per cent in Britain in 1953–4.[1] The distributions of the saving-ratios for each country (given in Table IV) show rather less difference than might be expected. The main difference is that the U.S. distribution is more widely scattered—in both the positive and negative directions—than the British. We have also made a comparison of distributions of saving-ratios within income tenths, and this shows the same features of a broad similarity of distribution accompanied by a greater dispersion of the U.S. ratios in every case. The only exception is that people near the top of the income scale more often report large negative saving in Britain than in the United States.

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[1] The saving-ratios used in this section of the paper are derived by dividing the survey concept of saving by net income, also on the survey definition, i.e. income after depreciation of non-corporate business assets (except U.S. farms), direct taxes (except State income taxes in the U.S.) and (in Britain only) social security contributions.

The greater dispersion of saving-ratios in the United States may be explained by four factors: first, there are slightly fewer retired people in the U.S. (13 per cent compared to 18 per cent). Retired people have rather stable incomes and save or dissave relatively small amounts in any particular year. Secondly, there are more self-employed persons in the United States (16 per cent compared to 7 per cent). They tend to have frequently fluctuating incomes and their saving-ratios are widely dispersed. Thirdly, the incomes of employed persons in the United States probably fluctate more than in Britain. Fourthly, purchases of major durable goods are more frequent in the United States than in Britain.

TABLE IV

Distribution of the Saving-Net Income Ratio[1]

(Percentage distribution of spending units—
United States 1950, Great Britain 1953–54)

Saving-Net Income Ratio	*All Spending Units*	
	U.S.	*G.B.*
Positive	*59.9*	*59.6*
50% and over	4.9	0.7
30–49%	9.3	2.9
20–29%	8.7	3.9
10–19%	15.6	12.3
1–9%	21.5	39.8
Zero	*8.6*	*11.8*
Negative	*31.6*	*28.6*
1–9%	11.1	14.9
10–19%	7.4	6.5
20–29%	3.8	2.6
30–49%	3.4	1.9
50% and over	5.8	2.7
Total	*100.0*	*100.0*
Number of interviews	3,415	2,463

[1] Percentages in this and subsequent tables do not always exactly add to totals, because of rounding.

The first three of these factors are dependent on the assumption that the greater the annual fluctuation in the incomes of a group of persons the wider will be the dispersion of their saving-ratios. The fourth factor springs from the following considerations. On the common definition of saving people who borrow one year to make a large purchase, and who pay back the money the next year, tend to appear as negative savers in the first year and as positive savers in the second. Similarly, people who build up bank balances in one year and spend the money on durables in the next year will appear alternatively as positive and negative savers. Hence, the greater the proportion of spending units who make major durable purchases in any given year the greater the probable dispersion of their saving-ratios.

The Effects of Income and Occupation

As a first step in our examination of income and occupation on saving we show in Table V averages of total saving (and certain related items) for each pre-tax income tenth. Since the relative dispersion of income is broadly similar in the two countries [17, pp. 45-50], an analysis by income tenths is a convenient way of comparing spending units at equivalent positions on the income scale.

It is a well-known phenomenon of cross-section surveys that they always show saving-ratios which rise with income. Friedman's explanation [8] of this is the variability of income from year to year, but although, as we have said, there is probably some truth in this hypothesis, we do not believe that it can account for the whole of the upward slope in the saving-ratios. Consider, for example, the contractual saving-ratios shown in Table V (p. 242). Contractual saving is, by its nature, a form of saving which is most unlikely to be influenced by ' transitory ' components of income. Hence, if Friedman's hypothesis were correct, one would expect contractual saving to be a constant proportion of ' permanent ' income at all levels of ' permanent ' income, or, in other words, to behave as he believes consumption behaves. In that case the ratio of contractual saving to ' measured ' income should *fall* as ' measured' income rises. In our figures we find such an inversion in the bottom tenth —possibly for the Friedman reason—but for the rest of the income scale we find no evidence of this tendency. On the contrary, the contractual saving-ratio *rises* with ' measured ' income (more in Britain than in the U.S.) and *a fortiori* it must rise even more steeply in relation to ' permanent ' income. Hence, at least a part of the upward slope of the saving-ratios must be attributed to a rising propensity to save out of ' permanent ' income.

But there remains the problem of explaining why the U.S. total saving-ratios (shown in Table V) have a steeper slope than the British (at least for incomes above the median). On a crude relative-income hypothesis we might have expected to find rather similar ratios at equivalent levels of income in the two countries. Part of the difference between the slopes of the ratios can be eliminated if we add expenditures on durables, the ratios of which to income have little or no slope in the United States but a positive slope in Britain.[1] After this adjustment, however, the two sets of ratios continue to show difference of slope, the American ratio being consistently above the British.

We have already mentioned a number of factors which could account for the differences between the American and British ratios. First, there is the larger volume of ' institutional ' saving in Britain (indicated by the larger net adjustment required for life insurance and pension funds), much of which probably accrues to the higher income groups; secondly, if we accept the hypothesis advanced in the previous section, in the period under review a high

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[1] The perceptive reader will note that the average ratio of durable expenditures to net income in the United States is given as 11.7 per cent in Table V and only 9.3 per cent (for 1950) in Table III. There are various possible reasons for this discrepancy, of which one is the difference in coverage of durables and another the different definition of income. By chance, the British ratios are identical for 1953–4 in Table V and for 1953 in Table III.

TABLE V

Ratios of Selected Items to Disposable Income by Income Tenths, All Spending Units
(United States 1950, Great Britain 1953–1954)

					Means of Selected Items as Per Cents of Mean Disposable Income									
	Mean Disposable Income		*Mean Saving*		*Total Saving*		*Contractual Saving*		*Durable Expenditures*		*Total Saving plus Durables*		*Number of Interviews*	
Pre-Tax Income Tenths	*U.S.* $	*G.B.* £	*U.S.* $	*G.B.* £	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*
Top tenth ...	8,606	1,014	2,026	100.3	23.5	9.9	7.2	7.2	11.6	7.8	35.1	17.7	480	468
Second tenth ...	4,957	666	550	6.9	11.1	1.0	7.1	4.6	12.2	7.5	23.3	8.5	366	279
Third tenth ...	4,122	565	310	18.2	7.5	3.2	6.8	4.8	12.5	6.5	20.0	9.7	355	254
Fourth tenth ...	3,568	493	256	9.5	7.2	1.9	7.4	4.4	12.1	5.0	19.3	6.9	311	243
Fifth tenth ...	3,089	424	112	12.7	3.6	3.0	6.6	3.9	12.8	4.0	16.4	7.0	315	224
Sixth tenth ...	2,635	365	−22	5.7	−0.8	1.6	5.1	3.4	11.9	4.7	11.1	6.3	296	210
Seventh tenth	2,121	300	22	−1.0	1.0	−0.4	5.1	3.5	10.2	4.6	11.2	4.2	309	210
Eighth tenth ...	1,653	223	3	−0.9	0.2	−0.4	5.7	2.0	10.7	2.1	10.9	1.7	289	204
Ninth tenth ...	1,112	156	−45	−11.6	−4.0	−7.4	4.9	2.1	8.4	2.4	4.4	−5.0	305	188
Bottom tenth ...	479	99	−426	−29.6	−88.9	−30.0	7.5	7.8	10.2	4.5	−78.7	−25.5	330	183
All spendg. units	3,233	429	278	10.9	8.6	2.5	6.6	4.8	11.7	5.9	20.3	8.4	3,356	2,463

British liquidity-ratio was exercising a generally depressing effect on the average British saving-ratio, and perhaps especially on the higher income groups; thirdly, there is probably less variability of income in Britain—even within fairly homogeneous occupational groups—than in the United States, so that the ' Friedman effect ' is less prominent there; and fourthly, and most important of all in relation to the *slope* of the saving-ratios, there are fewer self-employed in Britain. This brings us to a closer consideration of the differences between occupations.

The three principal occupation classes—between which there are marked differences in saving behaviour—are the self-employed, the retired, and employees. The self-employed are owners of non-corporate businesses, farms or professional practices. Their annual incomes are the ' profits ' of a year's operations, and these are frequently not known precisely until they have been computed at the end of the year by the accountants. Self-employed incomes fluctuate rather widely from year to year and the ' Friedman effect ' is an important influence on their observed saving behaviour. This one reason why the slope of their saving-ratios is much steeper than the slope of the saving-ratios of other occupation groups (see Table VI); but it is also probable that they have a higher marginal propensity to save out of 'permanent' income than other occupational groups. Certainly they have one very strong inducement to save (the need for funds for the expansion of their businesses) which is absent in other occupations. It can be seen from Table VI that the slopes of the saving-ratios of the self-employed are very similar in both the United States and Britain. But the self-employed represent 16 per cent of all spending units in the United States against only 7 per cent in Britain, and hence they have a marked effect in raising the slope of the overall U.S. saving-ratio compared with the British.

Spending units headed by retired people tend to be dissavers at all levels of income. No consistent trend is shown by the ratios in Table VI and the

TABLE VI

Total Saving-Ratios of Self-Employed and Retired Spending Units, by Income Groups

(Mean total saving as per cent of mean disposable income—
United States 1950, Great Britain 1953–54)

Tenths of pre-tax income[1]	*Self-employed*		*Retired*	
	U.S.	*G.B.*	*U.S.*	*G.B.*
Top tenth	32.7	27.3	5.1	−10.9
Second, third and fourth tenths	20.5	8.8		
Fifth, sixth and seventh tenths	8.0	5.3	−23.5	−9.6
Eighth tenth	−34.6	−96.9	−9.4	−3.0
Ninth tenth			−1.6	−7.7
Bottom tenth			−31.1	−7.8
All spending units	20.5	12.8	−8.4	−8.1
Number of interviews	869	242	254	320

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[1] The spending units are arranged according to their grading in the total income distribution. For example, those in the ' top tenth ' in this table are the spending units who fall into that group in the total income distribution.

most likely hypothesis is that in both countries the saving-ratios of the retired have no appreciable slope. The proportion of *old* people is larger in Britain than in the United States and the proportion of *retired* heads of spending units is also larger as already noted—18 per cent in Britain against 13 per cent in the United States—so that this factor adds something to the explanation of the difference in the overall slope of the saving-ratios.

The largest occupational group in both countries consists of spending units headed by employed persons. They represent about 71 per cent of all spending units in the United States and 75 per cent in Britain; and, because of their importance, it is worth devoting a little more detailed attention to their behaviour. In Table VII, therefore, we show their ratios of total saving and durable expenditures (by income tenths) and also the ratios of various components of their saving. In Table VIII we also show the percentage of employee spending units who save in different ways. A striking feature of Table VII is that, whereas the contractual saving-ratios of the two countries are very similar throughout the income scale, at the upper end of the scale the total saving-ratios are very different.

In Britain in 1953–4 discretionary (non-contractual) saving by upper income employees was, on average, negative, while in the United States in 1950 it was substantially positive. This may be explained by the fact that during and after the war higher salaries in Britain did not increase as rapidly as lower salaries and wage incomes, so that the wealth-income ratios of higher paid employees were abnormally large. Another possible explanation arises from the fact that in Britain there is a substantial amount of medium-term saving through life insurance endowment policies, the proceeds of which are used (on maturity) for current purposes, e.g., for private school and college fees. This process is encouraged by the tax reliefs allowed on life insurance premiums.

It is interesting to compare the proportions of employee spending units in each country who engage in the different kinds of contractual saving, and the average amounts saved in these ways. The percentage of employee spending units who make some kind of contractual payment varies with income in an almost identical fashion in the two countries (see Table VIII), and the total contractual saving-ratios are not very different (Table VII). But within the contractual total there are some divergences. Life insurance is very similar, but pension fund payments are more common in Britain and mortgage repayments more common in the United States. In recent years the proportion of American spending units contributing to a pension plan has grown very considerably, and the gap between British and American behaviour in this respect is unlikely to be as large now as it was in the two surveys used here.

Our conclusion from this part of the analysis is that income and occupation each account for part of the slope in the overall saving-ratios. So far as the self-employed and the retired are concerned the American and British data are similar; but there remain substantial differences between the saving-ratios

TABLE VII

Ratios of Selected Items to Disposable Income by Income Tenths, Spending Units Headed by Employees Only

(Mean of each item as per cent of mean disposable income-United States, 1950, Great Britain 1953–1954)

Pre-Tax Income Tenths[1]	*Total Saving*		*Contractual Saving*								*Durable Expenditures*		*Total Saving and Durable Goods*		*Number of Interviews*	
			Total		*Life Ins. Premiums*		*Pens'n Fund Contributions*		*Mortgage Repayments*							
	U.S.	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*[2]	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*
Top 5 per cent ...	19.9	8.6	7.3	9.0	4.1	3.7	0.5	2.5	2.7	2.8	9.7	9.6	29.6	18.2	115	200
Second 5 per cent	10.0	3.1	5.8	5.8	3.1	2.3	1.1	2.0	1.6	1.5	15.6	9.0	25.6	12.1	145	151
Second tenth ...	7.2	0.6	6.6	4.6	3.4	2.2	0.9	1.4	2.3	1.0	13.7	7.9	20.9	8.5	274	244
Third tenth ...	5.2	2.1	6.8	5.0	2.7	2.5	1.4	1.1	2.7	1.5	13.3	6.7	18.5	8.8	271	222
Fourth tenth ...	5.6	2.1	6.9	4.3	3.2	2.3	1.0	1.1	2.7	0.9	12.1	4.8	17.7	6.9	260	219
Fifth tenth ...	4.3	2.4	5.8	3.9	2.6	2.3	1.0	0.8	2.2	0.8	11.8	4.0	16.1	6.4	248	194
Sixth tenth ...	−1.4	1.8	4.8	3.4	2.7	2.6	0.5	0.6	1.6	0.2	11.8	5.0	10.4	6.8	243	189
Seventh tenth ...	1.2	2.2	4.2	2.8	2.4	2.0	0.4	0.8	1.4	0.1	8.3	3.7	9.5	5.9	220	176
Eighth tenth ...	−0.3	0.6	3.9	1.9	2.5	1.2	0.0	0.6	1.4	0.0	9.1	2.0	8.8	2.6	200	156
Ninth tenth ...	−4.7	−7.4	2.9	2.2	1.8	1.8	0.0	0.1	1.2	0.3	6.5	1.4	1.8	−6.0	170	105
Bottom tenth ...	−68.6	−11.6	4.2	3.2	2.5	3.2	0.2	0.0	1.5	—	4.4	1.9	−64.2	−9.7	146	45
All employee units	5.1	2.4	6.0	4.7	3.0	2.4	0.8	1.2	2.2	1.1	11.9	6.2	17.0	8.5	2,292	1,901

[1] See note to Table VI.

[2] This column was estimated as a residual.

of employees. In the hope of explaining some part of these differences, we examine the influence of two further factors, namely, the life cycle and home ownership.

The Effects of Life Cycle and Home Ownership

It seems reasonable to expect that age or the stage in the family life cycle should have some effect on the saving propensity. A number of previous investigations, e.g. [6, 16, 18], have shown that income varies both with age and with the family life cycle (which incorporates the influence of age, marital status and number of children). Typically, income rises from a relatively low level at younger ages, reaches a peak sometime in late middle age, and declines thereafter. There is also some evidence to suggest that the saving propensity rises with age, especially after middle age, up to the time of retirement [6, 18]. Durable expenditures, on the other hand, appear to be at a peak—in relation to income—amongst younger families. Hence when savings and durables expenditures are added together the young families appear more thrifty.

TABLE VIII

Per cent of Spending Units Who Save or Spend in Different Ways by Income Tenths, Units Headed by Employees Only

(United States 1950, Great Britain 1953–1954)

Tenths of Pre-Tax Income	*Contractual Saving*		*Life Insurance Premiums*		*Pension Fund Contributions*		*Mortgage Repayments*		*Purchase of Durables over $100 or £10*	
	U.S.	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*
Top 5 per cent ...	94	97	93	85	22	63	41	38	78	68
Second 5 per cent	98	94	91	83	29	55	26	29	79	71
Second tenth ...	95	89	92	79	28	41	34	18	74	63
Third tenth ...	93	91	87	82	27	37	34	19	66	60
Fourth tenth ...	93	87	89	80	25	32	30	16	63	51
Fifth tenth ...	87	84	78	77	24	22	28	12	56	40
Sixth tenth ...	85	82	82	78	20	18	14	3	51	41
Seventh tenth ...	71	70	68	63	12	21	11	1	30	30
Eighth tenth ...	68	56	64	50	7	16	9	[1]	33	14
Ninth tenth ...	48	45	41	44	5	5	6	2	22	7
Bottom tenth ...	36	40	32	39	1	1	8	[1]	9	12
All employee units	79	79	75	72	18	28	21	12	50	43

[1] Less than 0.5 per cent.

For the purpose of this inquiry we decided to use a classification by life cycle groups rather than by ages, on the ground that the life cycle grouping allows for the influences of marriage and the maintenance of children as well as of age itself. We have limited ourselves to studying the effects of the life cycle amongst employees, since we have already found that the saving-ratios for the self-employed are very similar in the two countries. For this group, therefore, we present in Tables IX and X two types of saving-ratios—the first excluding and the second including durable expenditures—for each

TABLE IX

Saving-Ratios by Life Cycle Groups within Income Groups, Employees Only

(Mean total saving as a percent of mean disposable income in each cell—United States 1950, Great Britain 1951–54)

Life cycle group[1]	Income Groups: Top 20%		2nd 20%		3rd 20%		Bottom 40%	
	U.S.	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*
Young, single	15.4	1.9	6.1	5.7	0.3	1.9	6.7	0.8
Young, married, no children	7.6	*	3.9	0.8	−3.1	−4.0	−3.2	(−)
Young, married, with children	10.0	2.0	5.9	2.1	0.9	1.3	−8.4	3.9
Older, married, with children	16.9	3.8	5.9	1.2	−2.5	3.7	−2.4	2.4
Older, married, no children	12.2	8.2	4.6	1.9	9.5	3.1	−4.8	1.4
Older, single	22.6	4.2	11.7	3.5	11.0	2.1	−22.3	*

[1] 'Young' means that the head of the spending unit is under 45; 'older' that he is 45 or over. 'With children' means that the spending unit contained some children under 18.

* Less than half the last digit shown.

(−) Less than 10 interviews in the cell.

of six life cycle groups by each of four income groups. (It has been necessary to limit the breakdown by income because of limitations on the sample size).

From Table IX it appears that the life cycle has some effect on the saving propensity, but not a very strong one.[1] Perhaps the most noticeable difference is between the young married couples with no children and the others.

TABLE X

Saving plus Durables-Ratios by Life Cycle Groups within Income Groups, Employees Only

(Mean total saving plus durable expenditure as a per cent of mean disposable income in each cell—United States 1950, Great Britain 1953–54)

Life Cycle group†	Income Groups: Top 20%		2nd 20%		3rd 20%		Bottom 40%	
	U.S.	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*	*U.S.*	*G.B.*
Young, single	23.3	6.3	21.4	15.9	12.9	5.6	11.9	3.7
Young, married, no children	24.8	9.1	20.2	7.3	11.5	7.9	6.3	(−)
Young, married, with children	23.0	11.3	17.5	8.3	14.5	5.4	4.8	9.6
Older, married, with children	29.0	11.8	16.3	5.9	11.9	8.1	3.9	6.1
Older, married, no children	24.1	15.3	16.7	6.2	15.4	8.2	7.5	3.8
Older, single	27.3	21.3	20.4	7.9	17.7	5.1	−19.4	1.8

† See note to previous table.

(−) Less than 10 interviews in the cell.

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[1] The more pronounced differences between age or life cycle groups revealed by previous investigations were probably influenced by the inclusion of the self-employed, who are more concentrated in the upper age groups and have a higher average saving propensity.

With one exception, young married couples save a smaller fraction of their income at each level of income than young single people or young couples who do have children. This result indicates that attempts to fit either a linear relation or a simple curvilinear relation between age and saving are not likely to be successful.[1]

When durable goods are included in saving, however, differences among stages in the life cycle tend to disappear, since younger people are relatively heavy spenders on durable goods (Table X). This finding seems to be in conflict with the results of work by Morgan [25].

Next, we consider the effect of home ownership. It has frequently been found, e.g. [25], that home owners have a different saving propensity from tenants, and especially that owners with a mortgage are heavier savers. To test the independent influence of this factor we have been obliged to break the sample of employees in three dimensions—by income, life cycle and home ownership. Because of the limited size of the sample some of the cells become thinly populated or entirely empty when the sample is broken down by so many variables. Accordingly, we have restricted ourselves in Table XI to the largest life cycle group (married people with children), and we present data for three broad income groups at the top of the distribution only, since these groups contain people with each home ownership status. In this table we are concerned with saving net of purchases of durable goods. The evidence in the table indicates that owners with a mortgage tend to be heavier savers than outright owners or tenants.[2] Strictly speaking the results apply to the special sub-group of the population covered in the table, but it is unlikely that the effect of home ownership would be different for other sub-groups.

TABLE XI

Saving-Ratios by Home Ownership within Selected Income Groups, for Employees who are Married with Children only

(Mean total saving as a per cent of mean disposable income in each cell— United States 1950, Great Britain 1953–54)

Income group	*United States*			*Great Britain*		
	Owners outright	*Owners with mortgages*	*Tenants*	*Owners outright*	*Owners with mortgages*	*Tenants*
Top 20%	19.3	16.4	1.1	0.4	4.3	2.4
2nd 20%	−0.6	12.2	2.1	3.5	6.3	1.5
3rd 20%	0.1	3.7	−3.2	(–)	1.8	2.3

(–) Less than 10 interviews.

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[1] We may have here an explanation of the difficulty encountered by Klein in fitting regression equations to British data [14].

[2] The only apparent exception of any consequence is for outright owners in the top income group in the United States, but this exception is more apparent than real. Income is only approximately held constant in the table and this cell contains an undue proportion of very high income people who save a high fraction of their income.

An Experiment in Re-Weighting the U.S. Survey Data

In view of our findings that occupation, life cycle and home ownership are all in some degree important in determining the saving-ratios, and since the structure of the American population differs quite substantially from the British in these respects, we decided to make the experiment of re-weighting the U.S. sample so as to approximate to the British population distribution of these variables. Since there are very few farmers in Britain—only about one per cent of all spending units—American farmers were excluded from this calculation (or, in other words, given a weight of zero). The remainder of the population was broken into about 70 sub-groups determined by their occupation, life cycle (representing various combinations of age, marital status and number of children) and home ownership characteristics; and a weight was given to each sub-group corresponding to the frequency of occurrence of the same sub-group in the British population (as estimated by the British survey).

The results of the re-tabulations of the American data are shown in Tables XII and XIII. The use of the British weights has two main consequences: it reduces the dispersion of the saving-ratio and it reduces the average level of saving of the population as a whole. Table XII shows how re-weighting has brought the distribution of the saving-ratio in the United States closer to the British distribution. Table XIII (p. 250) shows also how the income slope of the U.S. saving-ratio has been reduced. The effect of re-weighting is to cut average saving per American spending unit from $278 to $115, or from 8.6 per cent of net income to 4.2 per cent. This is much closer to the British figure of 2.5 per cent (for 1953–54) and, if account were also taken of the ' institutional ' forms of saving (which have a greater importance in Britain), there would be little further difference remaining to be explained.

TABLE XII

Distribution of Saving-Net Income Ratios,
Showing Effect of Re-weighting the American Data
(Percentage distribution of spending units)

	United States 1950		*Great Britain*
Saving-Net Income Ratio	*Unadjusted*	*Non-farm Units British weights*	*1953–54 Unadjusted*
Positive	*59.9*	*54.9*	*59.6*
50% and over	4.9	2.6	0.7
30–49%	9.3	6.0	2.9
20–29%	8.7	6.4	3.9
10–19%	15.6	15.3	12.3
1–9%	21.5	24.6	39.8
Zero	*8.6*	*12.9*	*11.8*
Negative	*31.6*	*32.2*	*28.6*
1–9%	11.1	12.7	14.9
10–19%	7.4	7.5	6.5
20–29%	3.8	4.1	2.6
30–49%	3.4	2.9	1.9
50% and over	5.8	5.1	2.7
Total	*100.0*	*100.0*	*100.0*
Number of interviews	3,415	3,027	2,463

Table XIII

Ratios of Selected Items to Disposable Income by Income Tenths—Weighted and Unweighted

(All spending units in the United States in 1950)

Pre-Tax Income Tenths	*Mean Disposable Income*		*Mean Saving*		*Means of Selected Items as Per Cents of Mean Disposable Income*							
					Total Saving		*Contractual Saving*		*Durable Expenditures*		*Total Saving Plus Durables*	
	a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*
	$	$	$	$								
Top 5 per cent ...	11,083	10,821	3,387	2,487	30.6	23.0	7.4	6.0	9.3	8.7	39.9	31.7
2nd 5 per cent ...	6,133	6,114	666	475	10.9	7.8	6.8	5.7	15.7	15.9	26.6	23.7
Second tenth ...	4,957	4,902	550	374	11.1	7.6	7.1	5.8	12.2	12.5	23.3	20.1
Third tenth ...	4,122	4,078	310	159	7.5	3.9	6.8	5.4	12.5	11.2	20.0	15.1
Fourth tenth ...	3,568	3,566	256	171	7.2	4.8	7.4	5.6	12.1	10.7	19.3	15.5
Fifth tenth ...	3,089	3,043	112	111	3.6	3.6	6.6	4.7	12.8	12.8	16.4	16.4
Sixth tenth ...	2,635	2,611	−22	−48	−0.8	−1.8	5.1	4.0	11.9	11.8	11.1	10.0
Seventh tenth ...	2,121	2,092	22	−4	1.0	−0.2	5.1	3.4	10.2	8.0	11.2	7.8
Eight tenth ...	1,653	1,628	3	2	0.2	0.1	5.7	4.3	10.7	7.9	10.9	8.0
Ninth tenth ...	1,112	1,093	−45	−42	−4.0	−3.8	4.9	3.2	8.4	5.5	4.4	1.7
Bottom tenth ...	479	505	−426	−200	−88.9	−39.7	7.5	3.0	10.2	2.8	−78.7	−36.9
All spending units	3,233	2,748	278	115	8.6	4.2	6.6	4.9	11.7	10.6	20.3	14.8

a Unweighted. *b* Weighted.

The effect of re-weighting on the contractual saving-ratios is fairly small —which is as it should be—and on the durable expenditure-ratios it acts mainly by reducing the figures for the lower income groups—which is also in the right direction.

Although the main purpose of our analysis has been to *explain* the observed differences between the saving behaviour of our two countries, we do not wish to imply that the level of personal saving in a nation depends solely upon the current value of its accumulated wealth, its annual income and the demographic and occupational composition of its population. To some degree the level of personal saving can be influenced by public policy. For example, as we have already mentioned, home ownership encourages saving; and home ownership can be stimulated by public policy.

We have also suggested that pension schemes tend to lead to increased saving. The effect of pension funds on total saving by employees is examined in Table XIV (p. 252). The first two columns under each country show mean saving for units who do not make pension fund payments compared to units who make such payments (not counting social security). At each income level those who make contributions to pension funds save more. The third column shows total saving *less* pension fund payments for those who make such payments. These amounts are about the same as *total* saving for those who do *not* make pension fund payments. It is possible that a larger sample and more refined analysis would show that pension fund payments are offset to some degree by reductions in other forms of saving, but it is unlikely that such analysis would show that these payments are fully offset. It is even less probable that consumers reduce their other saving because of pension contributions by their employers.[1] We conclude that a public policy of encouraging pension schemes is likely to lead to increased personal saving.

CONCLUSIONS

From our analysis of time-series data we have found that over the period 1948–58 the average British personal saving-ratio has been consistently below the American, but that it has had an upward trend. This is made even clearer when saving and durable expenditures are added together.

The different level and behaviour of the two countries' personal saving-ratios cannot be explained satisfactorily by existing theories of saving. We have offered the alternative hypothesis that (1) saving—as normally measured —is (by definition) equal to saving-plus-durables expenditure minus expenditure on durables and (2) the ratio of saving-plus-durables to current income is negatively related to the wealth-income ratio. This hypothesis has been tested by using liquid assets as a proxy for wealth, and in this form it seems to account reasonably well for the relative movements in the two saving-ratios over the period under review.

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[1] Cf. Miner [24] who shows that payments to pension and retirement funds do not tend to reduce the fraction of income devoted to life insurance.

TABLE XIV

A Comparison of the Ratio of Saving to Disposable Income for Units with Different Pension Fund Status, Employees Only
(Mean saving as a per cent of mean disposable income)

	United States 1950			*Great Britain* 1953–1954		
	Mean Total Saving		*Mean Saving Net of Pension Fund Payments for Units Who Make Pension Fund Payments*	*Mean Total Saving*		*Mean Saving Net of Pension Fund Payments for Units Who Make Pension Fund Payments*
Pre-Tax Income Fifths	*Units Who do Not Make Pension Fund Payments*	*Units Who Make Pension Fund Payments*		*Units Who do not Make Pension Fund Payments*	*Units Who Make Pension Fund Payments*	
	%	%	%	%	%	%
Top fifth	9.4	17.7	14.4	2.7	4.4	0.5
Second fifth ...	4.9	7.5	2.6	1.1	4.0	0.9
Third fifth ...	1.6	1.8	−2.4	1.1	5.7	2.2
Fourth fifth ...	*	7.2	4.9	−0.2	8.8	5.1
Bottom fifth ...	−23.4	4.8	3.5	−4.1	(−)	(−)
All spending units	3.7	10.8	6.9	1.2	4.4	0.9

* Less than 0.05 per cent. (−) Fewer than 10 interviews.

There remains the problem of explaining why the British saving-ratio has been below the American saving-ratio. In order to probe further into this problem we have compared the behaviour of British and American spending units as revealed by comparable cross-section surveys. These surveys show that income, occupation, life cycle and home ownership all exert some influence on the saving propensity.

The distributions of income in the two countries are broadly similar, but the distributions of occupation, life cycle characteristics and home ownership are very different. We have made the experiment of re-weighting the U.S. survey data to conform to the British distribution of these characteristics; and we have found that this re-weighting process brings the U.S. saving-ratios closer to the British.

Our analysis points to the conclusion that the British saving-ratio has been lower than the American for two main reasons: first, the excess wealth-income ratio in Britain, carried over from the war and only gradually eliminated; and secondly, the different structure of the British population, more especially the smaller proportions of self-employed persons and of home owners (or rather of home buyers), and the larger proportion of retired persons. As an offsetting factor, however, there has been in Britain—at least until recently—a larger proportion of contributors to pension funds than in the United States.

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Appendix I

SOURCES OF DATA IN TABLES I–III

For the years up to 1957 the main U.S. source is *United States Income and Output*, U.S. Department of Commerce, 1959. Revised figures for 1956 and 1957, and provisional figures for 1958, are given in *Survey of Current*

Business, July 1959. The system of table numbering in these publications is now standardized, so that references can be given simply as ' I and O ', followed by the table number.

For the U.K. the main source is the Blue Book *National Income and Expenditure*, 1959. This will be referred to as ' BB ', followed by the appropriate table number.

United States Data

Gross disposable income equals (1) I and O, Table II–1, line 24, plus (2) I and O, Table V–9, line 10, plus (3) surplus of State and local government retirement funds, supplied by the Department of Commerce.

Gross personal saving equals (1) I and O, Table II–1, line 26, plus items (2) and (3) in previous paragraph.

Net disposable income and net saving are obtained by subtracting estimated depreciation at current replacement cost on nonfarm residences, nonfarm noncorporate business assets and farms. These estimates were supplied privately by Raymond Goldsmith.

Gross personal physical investment in houses equals I and O, Table V–9, lines 2 and 6; in noncorporate enterprises and farms, I and O, Table V–9, lines 4, 5 and 7.

Change in liquid assets equals I and O, Table V–9, lines 19, 20 and 22.

Change in life insurace and pension funds equals I and O, Table V–9, line 26, plus the change in State and local government retirement funds,as given above.

Change in other assets and liabilities is the residual of gross personal saving.

Major consumer durable expenditures equals I and O, Table II–4, lines 27, 28, 61 and 81.

Liquid asset holdings at the beginning of year are obtained by taking the figure for 1946 from *Federal Reserve Bulletin*, August 1959, p. 1,057, lines V and W, and accumulating for the other years from the changes in liquid assets derived above.

United Kingdom Data

Gross disposable income equals (1) total personal income from BB, Table 2, minus (2) taxes on income and national insurance contributions (from the same source), minus (3) stock appreciation from Table 46, minus (4) farm income of companies, estimated roughly by the Central Statistical Office, minus (5) costs of property transfers, supplied by the C.S.O.

Gross personal saving equals the item shown in BB, Table 2, minus (3), (4) and (5) in the previous paragraph, plus the cost of home repairs met by the War Damage Commission, supplied by the C.S.O.

Net disposable income and net saving are obtained by subtracting estimated depreciation at current replacement cost on personally-owned houses, business and farms, given in BB, Table 57, and adding back item (5) in the first paragraph above.

Gross personal physical investment in houses is taken from BB, Table 24; and investment in noncorporate enterprises and farms equals gross fixed capital formation plus value of physical increase in stocks, both from BB, Table 24, minus item (5) in the first paragraph.

Change in liquid assets equals change in the following items from BB, Table 24: total National Savings, shares and deposits in building societies, and net personal deposits with London clearing banks.

Change in other assets and liabilities is again a residual.

Major consumer durable expenditures is item 'Total durable goods' in BB, Table 18.

Liquid asset holdings at the beginning of each year are obtained by taking 1947 figures for each type of asset from *Annual Abstract of Statistics* No. 84 and accumulating for the other years from the changes in liquid assets derived as above.

Appendix II

NOTE ON THE DIFFERENCES BETWEEN THE SURVEY AND NATIONAL ACCOUNTS ESTIMATES OF SAVING

In the main, the survey definitions of saving in the two countries are very similar: both of them are net of depreciation on noncorporate business assets (at book values) but gross of depreciation on houses; and they both compute the saving performed by life insurance and pension funds on the same basis, namely, by taking individual contributions less lump sums received. In some other respects the definitions vary: for example, the British estimates of saving by farmers are net, while the U.S. estimates are gross; the U.S. figures of saving through liquid assets include accrued interest on U.S. Saving Bonds, while the British estimates exclude accrued interest on National Savings Certificates.

A complete and accurate reconciliation between the survey and national accounts estimates of personal saving is virtually impossible because of non-availability of particular items; but it is fairly easy to identify the main sources of difference. In the U.S. the survey estimate of saving for 1950 was $14 billion, compared with an aggregate figure (on the definitions used in the first section of this paper) of $22.3 billion. About half of this difference is attributable to the survey's exclusion of noncorporate business depreciation. Relatively little is due to the difference in treatment of life insurance and pension fund saving. In Britain, on the other hand, the gap between the two esimates of saving is relatively wider (£288 million from the survey and about

£650 million from the national accounts) and most of it is attributable to the difference in treatment of life insurance and pension fund saving. Depreciation is not so important.

The difference between the two countries in the relative importance of the adjustment to be made on account of life insurance and pension fund saving is interesting. The net increase in these funds (which is the national accounting definition of saving from this source) is somewhat greater as a proportion of gross disposable income in Britain than in the United States (for example, it was 3.2 per cent in the U.K. in 1953 compared with 2.5 per cent in the U.S. in 1950); but on the survey definition the British figure is lower than the American figure (about one per cent in Britain in 1953 compared with about 2 per cent in the U.S. in 1950). Hence the adjustment which has to be made in Britain is larger than in America (more than 2 per cent compared with less than one per cent).

The principal reason for the lower British survey estimate of life insurance and pension fund saving appears to be the larger proportionate volume of lump sums paid out by British life insurance companies. On the best estimates available (from aggregate sources) these amounted to over 2½ per cent of gross disposable income in the U.K. in 1953 compared with about one per cent in the U.S. in 1950. The proportion of life insurance policies maturing (or being paid off) each year must be larger in Britain than in the United States. This could be accounted for partly by the larger proportion of older people in Britain; but it may also be due to a more frequent use of short-term endowment assurances in Britain, which carry substantial tax advantages.

THE DISPOSAL OF USED PLANT AND MACHINERY BY U.K. MANUFACTURING INDUSTRY 1948–49 AND 1956–57

By E. B. BUTLER.

I

The Economist's Interest in Disposals

Firms' disposals of capital assets which they have productively employed interest economists for several reasons. The sale for further productive employment of used capital equipment to firms in the same or other industries reflects the adaptability of capital, an adaptability due in part to technical flexibility but pre-eminently to the suitability of capital assets for profitable incorporation in other productive plans. Attention is drawn to this aspect of disposals by, for example, Prof. Lachmann's emphasis on the structure of the economy's capital and its relation to changing circumstances and plans.[1] What is the extent of such transactions, particularly as compared with investment in new capital assets? Any answer to this question must of course recognise that an asset does not need to be sold to be incorporated in a plan of production other than the plan of its inception. Within the firm it is an important task of the entrepreneur to accomplish such re-organisation.

Some kinds of capital lend themselves more readily to the improvisations of economic reorganisation than other kinds; for instance, markets for used buildings and machine tools thrive, as markets for used blast furnaces do not. Partly (perhaps largely) as a consequence of the different kinds of equipment they use, the extent to which firms dispose of their assets will vary from industry to industry. What is the pattern of this industrial variation? Is it a comparatively stable pattern? The data presented here throw light on these questions so far as manufacturing industry and one type of capital asset—plant and machinery—is concerned.

Questions relating to the (complex) dependence of disposals of equipments on various aspects of economic activity (output in relation to capacity, the rate of growth of output, technical progress) are suggested by the same general interest in adaptations of the economy's capital structure. Such matters can be considered at both the macro-economic and the more fundamental micro-economic level. In established firms decisions to dispose of equipment must normally be an integral part of decisions to invest in new equipment. Disposal decisions may precede or succeed investment decisions. Disposals for example may help to finance or make room for the installation of new equipment, or old equipment may be retained till new equipment is functioning smoothly or to see whether market conditions justify the joint operation of both old and new equipment. The possibilities in respect to disposals add a dimension of flexibility to investment decisions. The data here (which include data on acquisitions) cannot throw much light on these matters. There are no data at all for individual firms but only for industries. Amongst these they yield suggestive—but not decisive—comparisons of increases over the decade 1948–1957 between disposals and acquisitions. Regrettably they do not, because they are purely in value terms with no possibility of conversion to quantity terms, answer the question whether disposals rose or fell in volume as excess capacity in capital equipment became, towards the end of the decade, more prevalent in the British economy.

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[1] L. M. Lachmann, *Capital and its Structure*, Bell, London, 1956.

Data on the disposals of capital equipment are also relevant to the econometric development of some abstract models of the economic system, in particular those models created to explore the theory of economic fluctuations. Such models frequently incorporate the acceleration principle linking capital investment to the rate of change of total output. All that need be said here is that it has been postulated that when total output is falling capital disinvestment never exceeds the rate at which capital must be disposed of for ' physical ' reason of age, damage, etc.: in the downswing of the trade cycle there comes a time when the accelerator ceases to operate.[1] Unfortunately (even if they covered a longer time period than they do) the data presented here could only be a vague background to indicating the extent of this irreducible capital wastage. This is not necessarily without value in a field where information is so scarce. The econometric development of the models, incorporating as they do, not only the acceleration principle, but the multiplier, the marginal propensity to consume, inter-industry relations, time lags, etc., becomes, as greater and greater realism is sought, more and more complex. Even not entirely appropriate information may serve a useful purpose by narrowing the range of possibilities. In this respect its industrial grouping is perhaps the most relevant feature of the present information on disposals.

In the case of a single firm a decision to invest can take the form of acquiring either new or used equipment. Gross capital investment for national income purposes however, excludes firms' capital expenditure on existing assets. In its estimates for the annual National Income and Expenditure Blue Book the Central Statistical Office attempts therefore to exclude all but the costs of transfer of existing assets sold by one firm to another. Perhaps the chief official use of the data on disposals given here, which are derived from the Census of Production, is to help the C.S.O. to make this exclusion. No further comment on this aspect of the figures is made.[2]

II

The Data

The present data on disposals are not economically homogeneous. The Census of Production asks firms to state, in a combined figure, the proceeds of their disposals of plant and machinery including (*a*) secondhand sales

[1] See e.g. R. G. D. Allen, *Mathematical Economics*, Macmillan, London, 1956, p. 220.

[2] See *National Income Statistics Sources and Methods*, London, 1956, pp. 283, 160.

through merchants or directly to other businesses, (*b*) scrap sales and (*c*) the estimated proceeds of insurance claims in respect of plant destroyed or damaged. The separate contributions under each of these heads cannot be reliably estimated. They will obviously vary from industry to industry. Considering the figures for all manufacturing industry it may be guessed, on the basis of scraps of information,[1] that the proceeds of insurance claims constitute 10–20 per cent of the value of disposals. Scrap sales, so it is later suggested, probably compose rather less than 30 per cent. These surmises are consistent with the view—which seems general and which is supported by a comparison of the values of disposals and secondhand purchases for the years (1948, 1949, 1951)[2] when both were collected by the Census—that the value of disposals is predominantly composed of the proceeds of secondhand sales. This is the justification of using them as an indication of the extent and industrial pattern of the source of secondhand plant and machinery. It is what precludes their use, apart from other deficiencies, as more than the broadest background for estimating the value of capital wastage by scrapping, fire damage, etc.

In what has been said it is implicit that the value of disposals compounds different principles and procedures of valuation. The proceeds of secondhand and scrap sales are determined by market forces (more predictable, no doubt, in the second than in the first case). The values placed on plant and machinery insured under fire and accident policies are in respect of reinstatement or of indemnification. Only in the case of insurance policies for reinstatement does the principle of valuation correspond broadly to what the economic statistician perhaps ideally wants—valuation at current replacement cost *new*. Under policies for indemnification the most frequent procedure is to determine current values as equivalent to *written down* replacement cost.[3] Even if it were regarded as sufficiently important to do so, the Census Office and manufacturers could hardly be expected to eliminate this heterogeneity in the data on disposals: for example, a sale of equipment thought by one manufacturer to be scrap may (especially after reconditioning by the purchasing merchant) find a productive place amongst another manufacturer's equipment.

The Censuses of 1956 and 1947 were both sample inquiries.[4] The results

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[1] See e.g. *The Insurance Directory and Year Book, 1956–57*, Buckley Press, p. 9.

[2] Figures derived directly from Census of Production trade reports:

	Disposals	*Secondhand Acquisitions*
	£m.	
1948	11.8	19.9
1949	12.6	13.1
1951	12.7	13.6

I hope to publish later an analysis of the data on secondhand acquisitions collected by the Census in these years.

[3] See T. Barna, 'The Replacement Cost of Fixed Assets in British Manufacturing Industry in 1955', *Journal of the Royal Statistical Society*, Series A, Part I, 1957, p. 8.

[4] Samples of about 1 in 8 establishments in 1956 and 1 in 9 establishments in 1957 including in both years all the largest establishments. Sampling was not employed in Northern Ireland. See *Report on the Censuses of Production for 1955, 1956, 1957*. Introductory Notes, Board of Trade, London, 1959.

for the U.K. based on the samples are therefore subject to margins of uncertainty which are likely to be rather higher for disposals because of greater sampling variability than for such central census aggregates as sales or, in particular, acquisitions—also given here. Nevertheless the uncertainties are not *prima facie* so great as to preclude testing the figures in an investigation.[1]

In presenting (in Table I) the Census statistics of disposals and acquisitions the two earliest years (1948 and 1949) and the two latest years (1956 and 1957) have, respectively, been combined. The Table shows the acquisitions and disposals of plant and machinery for 22 manufacturing industry groups in absolute and proportionate terms for both two-year periods, the proportions which disposals bear to acquisitions and the proportionate increases in the value of acquisitions and disposals between 1948–49 and 1956–57. The comparisons of the beginning and end of the decade are better made with two-year figures. This is especially true as annual figures for disposals show a few cases of relatively large fluctuations between one year and the next.

The figures for the acquisitions of plant and machinery are not comparable with the figures for gross fixed capital formation in plant and machinery given by the Central Statistical Office in the annual National Income Blue Book.[2] The adjustments here to the published figures to bring in small firms and, in the case of 1948, Northern Ireland, are cruder than those available to the C.S.O. Acquisitions include the purchase of used, not only new, plant and machinery: the C.S.O., as already stated, attempts to exclude all but the costs of transfer of existing assets sold by one firm to another. One the other hand the C.S.O.'s figures include for 1948 and 1949 what the present figures do not, investment in plant and machinery by new firms not yet in active production. This investment is, however, included here for 1956 and 1957 thereby increasing the total for all manufacturing industry by about 6 per cent[3] over a total net of such investment.

III

The General Relation of Disposals to Acquisitions

Price indices (as has already been implied) do not exist to enable estimates of the increase in the volume of acquisitions and disposals between 1948–49 and 1956–57 to be ventured. Over the period the rise in the price of new plant and machinery—using the price index implicit in data given by C.S.O.[4] —was for all industries 35–40 per cent. Thus the 2½-fold increase between

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[1] An excellent example of fruitful results from the use in empirical work of statistics not perfectly suited to the purpose is J. C. R. Dow and L. A. Dicks-Mireaux's use of the statistics of unfilled vacancies for producing, with statistics of unemployment, indicators of the demand for labour. 'Excess Demand for Labour,' *Oxford Economic Papers*, February, 1958.

[2] E.g. *National Income and Expenditure 1958*, H.M.S.O., London,p. 61.

[3] This is the percentage for *all* investment including buildings.

[4] Op. cit., p. 56.

TABLE I

Acquisitions and Disposals of Plant and Machinery by U.K. Manufacturing Industries, 1948–49 and 1956–57

	1948 and 1949			*1956 and 1957*			*1956 and 1957 as percentages of 1948 and 1949*	
	Acquisitions	*Disposals*	*Disposals as % of Acquisitions*	*Acquisitions*	*Disposals*	*Disposals as % of Acquisitions*	*Acquisitions*	*Disposals*
	£m.			*£m.*				
Bricks, Pottery & Glass	20.8 (4.6)	0.8 (3.2)	3.8	40.2 (3.4)	1.1 (2.8)	2.9	192.8	145.5
Mineral Oil Refining	16.1 (3.5)	0.2 (0.7)	1.0	51.6 (4.4)	0.1 (0.3)	0.3	320.0	75.7
OtherChemicals & Allied Trades	56.5 (12.4)	2.8 (11.3)	4.9	186.8 (16.0)	4.9 (11.9)	2.6	330.6	175.2
Iron and Steel ...	39.2 (8.6)	1.4 (5.6)	3.5	159.8 (13.7)	1.6 (3.9)	1.0	407.7	117.8
Non-Ferrous Metals ...	10.7 (2.3)	0.5 (1.9)	4.4	26.3 (2.3)	0.7 (1.7)	2.6	244.8	144.0
Shipbuilding ...	6.6 (1.4)	0.2 (1.0)	3.7	12.9 (1.1)	0.6 (1.5)	4.7	195.1	247.7
Mechanical Engineering ...	35.1 (7.7)	3.0 (12.4)	8.7	95.9 (8.2)	6.9 (16.8)	7.2	273.1	227.3
Electrical Engineering ...	19.8 (4.3)	1.3 (5.4)	6.8	64.4 (5.5)	1.9 (4.7)	3.0	325.7	144.3
Motor Vehicles & Cycles ...	25.6 (5.6)	1.2 (4.8)	4.6	102.9 (8.8)	2.6 (6.2)	2.5	401.3	217.6
Aircraft ...	5.2 (1.1)	0.4 (1.6)	7.3	27.6 (2.4)	1.1 (2.6)	3.9	527.0	283.5
Other Vehicles ...	3.9 (0.8)	0.2 (0.8)	5.2	5.8 (0.5)	0.2 (0.5)	3.8	151.1	110.4
Metal Goods not elsewhere specified	22.7 (5.0)	1.4 (5.8)	6.3	47.9 (4.1)	2.2 (5.3)	4.5	210.8	151.8
Precision Instruments & Jew'y.	5.5 (1.2)	0.3 (1.1)	4.9	10.8 (0.9)	0.3 (0.8)	3.1	197.3	125.9
Rayon, Nylon & Silk	18.8 (4.1)	0.6 (2.5)	3.2	26.5 (2.3)	0.7 (1.8)	2.8	140.9	121.6
Other Textiles	50.9 (11.1)	3.5 (14.4)	7.0	69.4 (5.9)	6.2 (14.9)	8.9	136.4	173.4
Leather Fur & Clothing ...	11.9 (2.6)	0.9 (3.8)	7.9	11.9 (1.0)	0.9 (2.1)	7.4	100.3	92.8
Food, Drink & Tobacco ...	49.0 (10.7)	2.1 (8.6)	4.3	90.3 (7.7)	3.2 (7.8)	3.6	184.3	152.0
Manufactures of Wood & Cork	9.7 (2.1)	0.9 (3.8)	9.6	9.4 (0.8)	1.3 (3.1)	13.8	97.0	138.8
Paper & Board	10.0 (2.2)	0.4 (1.6)	4.0	49.0 (4.2)	0.5 (1.2)	1.0	490.8	124.9
Paper Products & Printing ...	21.9 (4.8)	1.6 (6.5)	7.3	45.0 (3.8)	2.2 (5.4)	5.0	205.8	139.4
Rubber ...	8.6 (1.9)	0.1 (0.6)	1.7	22.7 (1.9)	1.0 (2.3)	4.2	263.7	640.3
Other Manufacturing	9.1 (2.0)	0.6 (2.6)	7.0	12.5 (1.1)	1.0 (2.4)	8.1	137.4	158.7
Total	457.6 (100.0)	24.6 (100.0)	5.4	1169.6 (100.0)	41.3 (100.0)	3.5	255.4	167.2

1948–49 and 1956–7 in the value of acquisitions (£460mn. to £1,170mn.) is, in real terms, short (about 20 percentage points) of a two-fold increase. Even this exceeds the 70 per cent increase in the *value* of disposals. The total figures as they stand show the value of disposals falling between 1948/49 and 1956/7 from 5½ per cent to about 3½ per cent of the value of acquisitions. The higher percentage at the beginning of the decade must reflect the importance, at a time when new plant and machinery were difficult to secure, of dealings in secondhand equipment. Moreover secondhand prices seem to have been greatly affected as new equipment became ' easier ' to secure: their level must certainly have risen less than the 35 per cent rise of new plant and machinery prices.

A precise answer cannot be given to the question, ' Do these figures conform with reasonable expectations? '. If all disposals were of scrapped equipment, if all plant and machinery ' dropped dead ' at exactly 15 years of age (a length of life fairly typical of those assumed for the rates of depreciation allowed by the Inland Revenue for taxation purposes)[1] and was replaced by plant and machinery of exactly the same form, then if purchases of new plant and machinery had, over a long period, been growing at the rate of 10 per cent per year and if the value of scrapped plant and machinery were one-tenth of its current replacement cost, disposals would be about 2.5 per cent of the value of new purchases.[2]

How far this result of 2½ per cent bears on Table I obviously depends on the conformity to fact of the assumptions on which it is based. Over the decade 1948–57 (and the same information for the preceding 10/15 years would be relevant) the average rate of increase in gross capital formation in plant and machinery in U.K. manufacturing industry was rather more than 10 per cent with fairly considerable year to year fluctuations.[3] The average life of plant and machinery (and it is worth remembering what very capacious portmanteau words these are) seems likely to be greater than 15 years. At least the (considerable) discrepancies between Dr. T. Barna's and Mr. P. Redfern's estimates of fixed assets employed in British manufacturing strongly indicate that the lengths of life assumed in Inland Revenue taxation practice (and by Mr. Redfern) are shorter than average lives in practice.[4] The value of scrap equipment is, one gathers, usually less than one-tenth of its current replacement cost. The actual value of scrapped plant and machinery is likely therefore to be a good deal less than 2½ per cent of the value of acquisitions though it is no more than guesswork to pitch an estimate at 1 per cent. This figure is consistent with Table I's results. Disposals are almost certainly predominantly secondhand sales. Scrap sales at 1 per cent of acquisitions would constitute about 30 per cent of disposals.

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[1] See the Inland Revenue's ' Income Tax, Wear and Tear Allowances for Machinery or Plant '.

[2] These figures are the result of constructing a numerical example similar to P. Redfern's. See ' Net Investment of Fixed Assets in the U.K. ', *The Journal of the Royal Statistical Society*, Series A, 1955, p. 144.

[3] *National Income and Expenditure, 1958*, p. 60.

[4] See Mr. Redfern's contribution to the discussion of Dr. Barna's paper. Barna, op. cit, p. 37.

IV

Disposals Rates in Various Industries

Inferences about particular industry groups must, to some extent, be the consequence of the particular industrial classification used.[1] With this general caution in mind, eleven industries in one or other of the two periods contributed proportionately more to disposals than acquisitions; eight of them (an apparently very mixed bag)[2] contributed more in both periods. The percentage rates of disposals as compared with acquisitions show marked differences from industry to industry, ranging from those for 'Manufactures of Wood and Cork' and 'Mechanical Engineering' (above 7 per cent in both periods) to those for 'Iron and Steel' (under 3 per cent). However, if for each of the two periods, the industries are placed in descending order according to their rates of disposals, there is a close similarity in the order of the industries in the two lists[3]: there is an 'ordinal steadiness' in spite of the large variations amongst industries in the contemporaneous changes in the level of disposals and acquisitions. The rate of disposal in each industry (though as calculated here obviously arithmetically dependent on the general level of investment) is, one may reasonably surmise, strongly influenced by some combination of factors (type of plant and machinery, the size distribution of firms, etc.) specific to the industry. Industries can fairly be distinguished into those with relatively high and those with relatively low rates of disposal. Nor, it must be added, does this result depend on the data having been combined in two-yearly periods.

Dr. Barna's research enables something to be said on what distinguishes 'high' and 'low disposal' industries. He has published, with due regard to margins of error, estimates—which like the data in Table I can be reassigned to an 18-group industrial classification—of the value of plant per employee and of the value of fixed assets per £1 of value added in British manufacturing industries.[4] If the disposal rates for 1956–1957 are compared with these estimates, which relate to mid-1955 and 1954 respectively, there is apparent a tendency for disposal rates to be inversely associated with values of plant per employee and values of fixed assets per £1 of value added.[5] Disposal rates are high—to use a conveniently descriptive phrase—in the less capital intensive industries. For example of the six industries[6] with the highest rates of disposal only one[7] has a value of plant per employee above the average for all manufacturing industry; three have the lowest values of all.

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[1] See Yule and Kendall, *An Introduction to the Theory of Statistics*, Griffin, London, 14th edition, 1953, p. 310.

[2] Mechanical Engineering; Aircraft; Metal Goods; Other Textiles; Leather, Fur and Clothing; Manufactures of Wood and Cork; Paper Products and Printing; Other Manufactures.

[3] Spearman's rank correlation coefficient works out at +0.77.

[4] T. Barna, op. cit., 1957, pp. 16 and 24.

[5] The rank correlation coefficients are of the order of −0.65. Value added per employee and assets per employee are, of course, positively associated. See Barna, op. cit., p. 26.

[6] Manufactures of wood and cork; Textiles other than rayon, nylon and silk; Other manufacturing; Leather, fur and clothing; Mechanical engineering; Shipbuilding.

[7] Textiles other than rayon, etc.

Only speculation is possible here about the determinants of this fact. Scrutiny of the six industries suggests that 'high disposal' industries are composed of small firms employing, to a considerable extent, fairly general purpose equipment. Small manufacturing firms are unlikely to employ large amounts of capital per employee and general purpose equipment lends itself to secondhand transactions—through which small firms acquire and dispose of plant more readily than large firms.

V

Disposals and Acquisitions in the Various Industries over thc Decade

In answering the question 'How are disposals associated with new investment over time?' comparisons are made between percentage increases over the decade in the value of acquisitions and disposals. To compare values of different times is to compare the compounding of price and quantity changes. During a period of rapid price increases and for a period like a decade, the factors tending to keep in line the price changes of *new* plant and machinery purchased in each industry are, no doubt, important, but in some industries considerable divergences from the average change for all industries are almost certain to occur. Comparisons of the values of disposals are obscured even more by the heterogeneous nature of the components of disposals. Perhaps one may reasonably surmise that the prices of all kinds of scrapped equipment move fairly closely together. The same is probably true of secondhand general purpose equipment with a wide market in many industries, but the prices of secondhand equipment specific to one industry are—naturally—greatly affected by factors specific to that industry. Furthermore not only are the factors influencing the prices of the different components of disposals fairly distinct but, over time, the proportionate relationship of the components in disposals can change.

Price indices for new plant and machinery of various kinds are, though now non-existent, conceivable even if they would be rather capricious examples of their kind. The practical and conceptual difficulties of compiling price indices for secondhand equipment (to select the main component of disposals) are very great—perhaps insurmountable. The economist interested in disposals is badly handicapped.

Nevertheless the question posed above on the association of new acquisitions and disposals is worth pursuing even though all that can be finally claimed is that the data are not inconsistent with reasonable hypotheses about the problem. (Any answer based on industry data could at best only be partial.)

Broadly the data show that industries in which percentage increases in the value of disposals between 1948–49 and 1956–57 are lower than the average in industries which experienced percentage increases in acquisitions of plant and machinery lower than the average.[1] Tests[2] however show this broad positive association to be barely significant statistically.

One nevertheless remains tempted to see economic appropriateness in the fact that 11 of the 13 industries where acquisitions increased less than the average increased disposals less than the average. In an economically buoyant period, like that during the decade, a relatively slow expansion of an industry's new investment seems likely to signify that it is an industry where many firms are unable, partly because of their relative unattractiveness to outside investors, to fulfil all their investment plans and/or where many firms, justified by the prevailing high level of demand, continue business without immediate reorganisation. Such firms are likely to become increasingly reluctant to part with old capital assets.

Observations on the 9 industries which increased their acquisitions more than the average must be statistically and economically even more ambiguous. They exceed and fall short of the average percentage increase in disposals in about equal numbers. Various surmises are, no doubt, possible. For example rapidly rising new investment may—especially if important new techniques are thereby introduced—impose on firms and their competitors considerable measures of industrial reorganisation which entail rising disposals of old assets. On the other hand where the new investment is designed, in response to urgent customer demand, to expand production on more or less established lines it may be accompanied, temporarily at any rate, by a longer retention of old assets.

These plausible enough conjectures must regrettably remain conjectures without some indication of the underlying changes in the quantities of disposals and acquisitions.

The conclusion—of much the same purport—to be drawn from Table II must be also basically a conjecture, at least if one extends it beyond its explicit statement in terms of value of disposals.

There are two readily available criteria of industrial expansion for classifying the 22 industries' percentage increases over the decade in (*a*) acquisitions and (*b*) employment. Table II lists the 22 industries in 4 groups according to

[1] *Acquisitions and Disposals, 1948–49 to 1956–57*

		No. of industries showing increase in acquisitions		
		Below U.K. average	Above U.K. average	
No. of industries showing increase in disposals	Below U.K. average	11	4	15
	Above U.K. average	2	5	7
		13	9	22

[2] The Spearman rank correlation coefficient between the orderings of the industries in respect of percentage increases in (a) acquisitions and (b) disposals and also the X^2 test applied to the table in the preceding footnote.

whether they expanded more or less than the average for all manufacturing industry in respect of acquisitions and employment. Against each industry is stated its rank obtained from listing the 22 industries in the descending order of their percentage increases in *disposals*. Finally an ' average rank ' for each of the 4 groups is given.

TABLE 2

Ranking of 22 U.K. Manufacturing Industries by percentage increasee in Disposals, 1948–9 to 1956–7

		Industries with percentage increase in employment			
		Below Average		Above Average	
Industries with percentage increase in acquisitions	Below Average	Shipbuildings	(3)	Non-Ferrous Metals	(13)
		Metal Goods n.e.s.	(10)	Paper Products and Printing	(14)
		Bricks	(11)	Food, Drink, Tobacco	(9)
		Precision Instruments	(16)	Other Manufacturing	(8)
		Other Vehicles	(20)	Median Rank	11
		Other Textiles	(7)		
		Rayon	(18)		
		Leather, Fur, Clothing	(21)		
		Wood and Cork	(15)		
		Median Rank	15		
	Above Average	Iron and Steel	(19)	Paper and Board	(17)
		Oil	(22)	Motor Vehicles	(5)
		Mechanical Engineering	(4)	Chemicals	(6)
		Median Rank	19	Aircraft	(2)
				Electrical Engineering	(12)
				Rubber	(1)
				Median Rank	5.5

NOTE. *Within* each of the 4 groups the higher the industry is listed the greater its relative rise in acquisitions as compared with its relative rise in employment.

On the whole—to make a commonsense rather than statistically indisputable judgment—it is amongst the most rapidly expanding industries that industries where disposals increased most are most likely to be found.

This point can be illustrated in another way by comparing the data for acquisitions and disposals with indices of industrial production[1]—though to do this the 22 industries have to be reduced to 14. There is a close similarity[2] between the orderings of the 14 groups in respect to proportionate increases in production between 1948–49 and 1956–57 and in respect to proportionate increases in acquisitions. In all the 9 industries where production rose less than the average the same was true of the value of disposals of plant and machinery, of the 5 industries where it rose more than the average 4 increased their disposals more than the average.

[1] *Board of Trade Journal*, Nov. 29th, 1952, p. 1032, and July 4th, 1958, p. 11.
[2] Spearman rank correlation coefficient +0.73.

Summary

There are good reasons why economists are interested in disposals of used capital equipment. Census of Production data on the value of disposals and acquisitions of plant and machinery by industries indicates that there are relatively high and relatively low disposal industries—industries broadly distinguished, it seems clear, by fundamental structural differences. Also, although without price indices their analysis remains partial, the data do not contradict,—rather they support,—the plausible hypothesis that disposals are likely to increase most in industries expanding most.

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